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A Study of the Food Habits and Physical Development of Preschool Children Over a Two-Year Period, with Special Reference to Seasonal Variations in Growth

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A STUDY OF THE FOOD HABITS AND PHYSICAL DEVELOPMENT OF PRESCHOOL CHILDREN OVER A TWO-YEAR PERIOD, WITH SPECIAL REFERENCE TO SEASONAL VARIATIONS IN GROWTH

HUGHINA McKAY AND MARY BROWN PATTON

In a former study of the growth of children (13), it was noted that the rate of gain in weight varied with the seasons (such gains being greater during the period from May through October than from November through April), although no seasonal variations in rate of gains in height were noted. Because of the large number of children included in the study, it was impossible to keep other than very general records of the food habits of the children, and the influence of food intake upon the rate of growth could not be noted.

The present study was undertaken to collect more data concerning possible seasonal variations in growth and to determine, if possible, to what extent food influenced such seasonal variations. In addition, it was realized that a long time investigation into the food habits of preschool children would add to the somewhat meager data available concerning food requirements of preschool children.

The group studied consisted of eight children, ranging from 19 to 40 months of age at the beginning of the study. Four of the children were from a group to be admitted later to the Home Economics Nursery School of The Ohio State University, and four were enrolled in the nursery school at the beginning of the study. A ninth child was added to the group during the first year and one of the children moved from the city during the second year. It was possible to make observations on the food intake of six children for each of the four seasons of a 2-year period, a total of 8 weeks. Of the three others, one child was out of the city during the time collection of data for the spring of 1932 was made and was, therefore, not included during that season, leaving a total of 7 weeks of observation for him. Food intakes for the two other children were observed for 5 and 6 weeks, respectively. Collection of data extended from January 1932 to January 1934, inclusive.

The children included in the study were all living in private homes, the parents being above the average in regard to the intelligence with which they provided for the needs of their children. In all cases, the economic status was such that adequate provision for food and for other needs was possible. All the children were examined by the same pediatrician at the beginning of the study and at approximately 3-month intervals thereafter and all were described as being normal, healthy, and in good nutritional condition. Table 1 gives data concerning the sex, age, height, and weight of the children.

Through the cordial cooperation of the Director of the Nursery School, contacts were made with the parents whose children were to be included in the study. Much credit and appreciation are due and are hereby given to the mothers who cooperated so faithfully during the 2-year period and who made it possible to maintain the personnel of the group practically unchanged during the long period of the study.

TABLE 1.—The Age, Height, and Weight of Nine Preschool Children

Child	Sex	Date of birth	Beginning of observation			Woodbury Standard Pounds	Difference in per cent
			Season	Height Inches	Weight Pounds		
1.....	Boy	Aug. 8, 1930	Summer 1932	35.12	28.31	29.12	—2.78
2.....	Boy	June 25, 1930	Winter 1932	33.50	29.31	26.50	10.60
3.....	Boy	June 22, 1930	Winter 1932	32.75	30.38	25.50	19.14
4.....	Girl	May 23, 1930	Winter 1932	32.62	28.19	24.62	14.50
5.....	Girl	Jan. 20, 1930	Winter 1932	34.50	26.50	27.50	—3.64
6.....	Girl	Nov. 10, 1929	Winter 1932	36.12	35.12	30.12	16.60
7.....	Boy	Aug. 4, 1929	Winter 1932	38.25	36.50	33.50	8.96
8.....	Boy	Feb. 26, 1929	Winter 1932	38.12	32.88	33.24	—1.08
9.....	Girl	Sept. 29, 1929	Winter 1932	37.12	29.68	31.24	—4.99

Data concerning the food intake of the individual children were obtained through weighed dietary studies. Young women trained in the method went into the homes and weighed the food eaten there by each child during one week for each season of the 2-year period. When the children were in the nursery school for the noon meal, their food intake was weighed in a similar manner.

As a routine procedure, menus for the noon meals which are to be served in the nursery school each week, accompanied by suggestions for breakfast and supper, are always sent to the parents in advance. This plan was followed during the study. Every effort was made to have the procedure the same during the study as at other times. When the children had their noon meal in the nursery school, it was possible to obtain weighed records of their food intake without the children's knowledge. When the records were made in the homes, the same worker was assigned, as far as possible, to the same children. The children seemed to accept the presence of the worker as a matter of course and to eat their meals in the customary manner during all the periods of observation.

Food intakes as shown for the week's period of 7 consecutive days were taken as indicative of the child's food consumption habits during the season each observation was made. Calculations based on the foods actually eaten by each child during one week of each season he was observed were made and are presented in this report.

Each child in the group was weighed and measured monthly, except during such periods as he might be out of the city—for example, during the summer vacation. Information concerning certain health habits of the children was obtained from the mothers and from the nursery school records. Medical and dental examinations were made periodically.

Results of the study are discussed as follows: Food intake with reference to calories, protein, minerals, vitamins, specific foods used by each child, and increases in weight and height.

A comprehensive review of the studies which have been published concerning the energy requirements of children is published in the report of the Committee on Growth and Development of the Child of the White House Conference on Child Health and Protection (29). Studies which have been made concerning the protein balance and protein intake of children have been summarized by Wait and Roberts (26) and by McKay and Evans (14). A survey of the literature concerning the mineral metabolism and mineral intakes of children has also been made by Wait and Roberts (27).

CALORIE INTAKE OF PRESCHOOL CHILDREN

In considering the food intake of children, as well as of adults, first interest is with the number of calories represented in the food consumed. Although the other food factors are as essential as calories, it is true, as Rose (16) says, that "In ordinary daily life, few of these can be secured independently of the energy supply, while all of them may and most of them must be obtained incidentally to it."

Table 2 and Figure 1 show the average calorie intake of the children for one week during each of the four seasons for 2 years. Figure 2 shows the average calorie intake of each child for each of the 2 years.

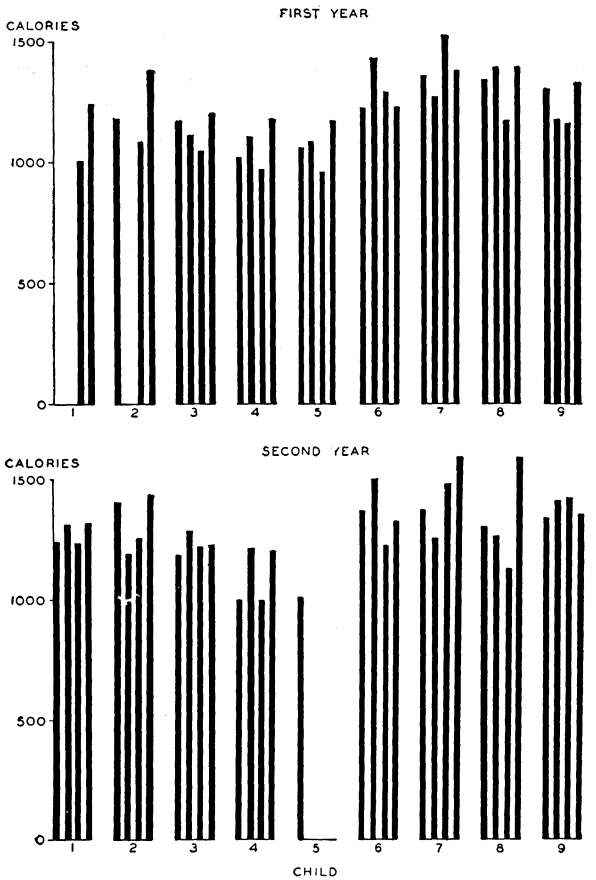

Fig. 1.—Seasonal variation in the calorie intake of individual preschool children during each of two years

TABLE 2.—Average Food Intake of Preschool Children for One Week During Each of Four Seasons for a 2-year Period

Season	Age Mos.	Weight Kg.	Height Cm.	Days of observation	Total daily intake: Protein Gms.	Fat Gms.	Carbohydrate Gms.	Calories	Calories per kg.	Calories per cm.	Calories per in.
Child 1 (Boy) First year											
Winter	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Spring	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Summer	22	12.84	89.20	7	42.2	44.3	108.9	1001	78.0	11.2	28.5
Autumn	25	14.01	93.01	7	51.3	53.7	139.1	1244	88.8	13.4	34.0
Average of first year	.....	.....	.....	.....	46.8	49.0	124.0	1122	83.4	24.6	31.2
Second year											
Winter	28	14.51	94.62	7	50.4	53.6	141.7	1248	86.0	13.2	33.5
Spring	31	15.34	97.16	7	47.7	56.2	156.4	1320	86.0	13.6	34.5
Summer	34	15.11	99.36	7	46.4	50.4	150.2	1238	81.9	12.5	31.6
Autumn	37	16.30	101.60	7	47.7	48.9	174.0	1325	81.3	13.0	33.1
Average of second year	.....	.....	.....	.....	48.0	52.3	155.6	1283	83.8	13.1	33.2
Child 2 (Boy) First year											
Winter	19	13.29	85.09	7	43.8	45.8	151.6	1180	89.8	14.0	35.6
Spring	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Summer	25	14.97	92.70	7	50.3	39.4	135.1	1097	73.3	11.8	30.1
Autumn	28	14.94	94.62	7	48.8	52.1	182.0	1391	93.1	14.7	37.3
Average of first year	.....	.....	.....	.....	47.6	45.8	156.2	1223	85.4	13.5	34.3
Second year											
Winter	31	15.70	96.82	7	48.6	53.8	184.2	1414	90.1	14.6	37.1
Spring	34	15.90	98.42	7	43.5	38.0	170.5	1198	75.3	12.2	30.9
Summer	37	16.53	100.03	7	48.3	47.9	160.3	1266	76.6	12.7	32.1
Autumn	40	16.87	102.87	7	51.0	50.8	194.6	1439	85.3	14.0	35.5
Average of second year	.....	.....	.....	.....	47.8	47.6	177.4	1329	81.8	13.4	33.9
Child 3 (Boy) First year											
Winter	19	13.78	83.18	7	40.8	49.0	144.2	1180	85.6	14.2	36.0
Spring	22	14.29	85.39	7	39.7	47.5	133.7	1120	78.4	13.1	33.3
Summer	25	14.26	87.60	7	39.4	43.0	125.8	1046	73.3	11.9	30.3
Autumn	28	14.63	90.17	7	38.2	45.2	161.9	1205	82.4	13.4	34.0
Average of first year	.....	.....	.....	.....	39.5	46.2	141.4	1138	79.9	13.2	33.4
Second year											
Winter	31	15.42	92.71	7	38.6	44.7	160.4	1196	77.6	12.9	32.8
Spring	34	16.13	95.88	7	44.1	49.4	167.2	1288	79.8	13.4	34.1
Summer	37	16.38	97.16	7	43.6	48.2	152.8	1218	74.3	12.5	31.8
Autumn	40	17.49	100.33	7	39.1	46.1	163.9	1226	70.1	12.2	31.0
Average of second year	.....	.....	.....	.....	41.4	47.1	161.0	1232	75.4	12.8	32.4

TABLE 2.—Average Food Intake of Preschool Children for One Week During Each of Four Seasons for a 2-year Period—Continued

Season	Age Mos.	Weight Kg.	Height Cm.	Days of observation	Total daily intake: Protein Gms.	Fat Gms.	Carbohydrates Gms.	Calories	Calories per kg.	Calories per cm.	Calories per in.
Child 4 (Girl) First year											
Winter	20	12.79	82.85	7	30.4	48.8	115.2	1022	79.9	12.3	31.3
Spring	23	13.07	85.09	7	37.8	52.5	121.7	1109	84.8	13.0	33.1
Summer	26	13.27	87.33	7	39.8	51.5	87.6	972	73.2	11.1	28.3
Autumn	29	13.89	90.17	7	42.7	51.8	135.2	1176	84.7	13.0	33.1
Average of first year	.....	.....	.....	.....	37.7	51.2	115.0	1070	80.6	12.4	31.4
Second year											
Winter	32	14.69	92.08	7	33.5	43.7	119.5	1005	68.4	10.9	27.7
Spring	35	15.73	94.62	7	46.4	54.7	134.4	1215	77.2	12.8	32.6
Summer	38	16.16	97.49	7	42.1	45.8	105.1	1000	61.9	10.3	26.0
Autumn	41	15.56	97.49	7	42.8	49.5	148.8	1211	77.8	12.4	31.6
Average of second year	.....	.....	.....	.....	41.2	48.4	127.0	1108	71.3	11.6	29.5
Child 5 (Girl) First year											
Winter	24	12.02	87.63	7	31.3	42.9	138.1	1062	88.4	12.1	30.8
Spring	27	12.50	87.63	7	32.4	43.9	139.7	1082	86.6	12.4	31.4
Summer	30	12.75	90.47	7	29.6	37.8	122.7	953	74.7	10.5	26.7
Autumn	33	13.38	93.68	7	34.8	40.4	166.8	1169	87.4	12.5	31.7
Average of first year	.....	.....	.....	.....	32.0	41.2	141.8	1066	84.3	11.9	30.2
Second year											
Winter	36	14.09	94.95	7	31.7	35.7	142.4	1017	72.2	10.7	27.2
Spring	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Summer	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Autumn	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Average of second year	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Child 6 (Girl) First year											
Winter	26	15.93	91.74	7	39.9	48.8	160.0	1238	77.7	13.5	34.3
Spring	29	16.50	92.08	7	49.3	59.8	173.7	1431	86.7	15.5	39.5
Summer	32	17.06	94.62	7	52.0	56.8	145.0	1297	76.0	13.7	34.8
Autumn	35	18.03	98.09	7	44.1	54.8	141.2	1232	68.4	12.6	31.9
Average of first year	.....	.....	.....	.....	46.3	55.0	155.0	1300	77.2	13.8	35.1
Second year											
Winter	38	18.85	100.03	7	47.2	51.8	180.5	1375	72.9	13.7	34.9
Spring	41	19.87	103.17	7	50.1	55.5	200.6	1501	75.5	14.5	36.9
Summer	44	20.10	105.71	7	47.4	47.9	153.6	1234	61.4	11.7	29.6
Autumn	47	20.78	108.25	7	47.6	47.4	176.3	1321	63.6	12.2	31.0
Average of second year	.....	.....	.....	.....	48.1	50.6	177.8	1358	68.4	13.0	33.1

TABLE 2.—Average Food Intake of Preschool Children for One Week During Each of Four Seasons for a 2-year Period—Concluded

Season	Age Mos.	Weight Kg.	Height Cm.	Days of observation	Total daily intake: Protein Gms.	Fat Gms.	Carbohydrates Gms.	Calories	Calories per kg.	Calories per cm.	Calories per in.
Child 7 (Boy) First year											
Winter	29	16.56	97.16	7	41.0	57.2	170.0	1357	81.9	14.0	35.5
Spring	32	16.81	98.09	7	42.0	51.1	161.5	1273	75.7	13.0	33.0
Summer	35	17.35	100.63	7	52.4	64.8	184.7	1529	88.1	15.2	38.6
Autumn	38	17.69	102.87	7	46.6	55.3	175.5	1384	78.3	13.5	34.2
Average of first year					45.5	57.1	172.8	1386	81.0	14.4	35.3
Second year											
Winter	41	18.48	104.44	7	43.7	51.5	185.2	1377	74.5	13.2	33.5
Spring	44	19.50	106.38	7	42.1	47.1	167.5	1262	64.7	11.9	30.1
Summer	47	20.01	108.58	7	50.6	66.3	171.6	1484	74.2	13.7	34.7
Autumn	50	20.21	110.79	7	54.7	56.6	217.7	1597	79.0	14.4	36.6
Average of second year					47.8	55.4	185.5	1430	73.1	13.3	33.7
Child 8 (Boy) First year											
Winter	35	14.91	96.82	7	41.0	58.8	163.2	1349	90.5	13.9	35.4
Spring	38	15.02	98.42	7	46.0	60.2	167.3	1393	92.7	14.2	36.0
Summer	41	15.74	100.96	7	39.2	52.4	136.4	1172	74.5	11.6	29.5
Autumn	44	16.78	102.87	7	49.5	59.1	167.4	1398	83.3	13.6	34.5
Average of first year					43.9	57.6	158.6	1328	85.2	13.3	33.8
Second year											
Winter	47	17.18	104.44	7	45.4	51.1	166.0	1304	75.9	12.5	31.7
Spring	50	17.83	106.53	4	40.9	53.1	157.1	1268	71.1	11.9	30.2
Summer	53	18.37	107.95	7	42.4	48.3	131.2	1127	61.4	10.4	26.5
Autumn	56	20.21	111.46	7	52.5	60.3	211.0	1595	78.9	14.3	36.3
Average of second year					45.3	53.2	166.4	1324	71.8	12.3	31.2
Child 9 (Girl) First year											
Winter	40	13.46	94.28	7	41.5	49.1	175.0	1307	97.1	13.9	35.2
Spring	43	13.49	94.95	7	41.1	42.2	159.1	1179	87.4	12.4	31.5
Summer	46	13.98	97.49	7	37.6	40.0	161.2	1154	82.6	11.8	30.1
Autumn	49	14.57	99.70	7	47.3	49.4	175.3	1334	91.6	13.4	34.0
Average of first year					41.9	45.2	167.7	1244	89.7	12.9	32.7
Second year											
Winter	52	15.22	100.96	7	44.1	45.3	189.9	1343	88.2	13.3	33.8
Spring	55	15.37	103.50	7	47.4	55.6	182.7	1419	92.3	13.7	34.8
Summer	58	16.36	105.11	7	50.9	50.2	193.3	1428	87.3	13.6	34.5
Autumn	61	17.04	107.32	7	52.4	49.9	175.7	1360	79.8	12.7	32.2
Average of second year					48.7	50.3	185.4	1388	86.9	13.3	33.8

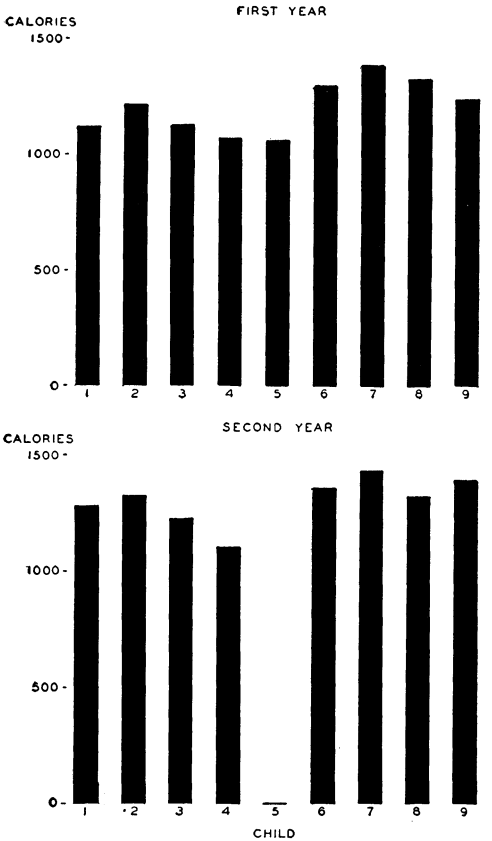

Fig. 2.—Average calorie intake of individual preschool children for each of two years

TOTAL CALORIES

Average calorie intakes for the 7-day periods increased fairly consistently with age. In the main, the older children consumed more calories than the younger children. The weekly average for the group of older children exceeded the average for the group of younger children, although in occasional individual cases a younger child had more calories than some individual in the older group. In one case, the average weekly calorie intake of a younger child exceeded corresponding calorie intakes of all the other children. In all the other cases, highest calorie intakes for the week were among the older children.

Somewhat surprisingly, calorie intakes did not increase consistently with individual children as they grew older; that is, during the week the observations were made a child did not always average a higher food intake than he had averaged during the corresponding week of the preceding observation period. See Figure 1. This may indicate that had the food intake been

observed over a longer period each season different results might have been obtained and that daily variations were such that one week was too short a period to give a complete picture of the child's food habits. Perhaps activity was decreased during some of the seasons and food needs thereby lessened. Possibly the child was getting less food during these specific seasons than was needed for optimal growth.

Had the calorie intake increased consistently, as one might expect from season to season, the lowest intake for each year would have occurred in the winter, at which time the first observations for each year were made, and would have increased during each successive season (spring, summer, and autumn), with all the highest intakes of the year occurring in the autumn, the season of the last observation for each year. For 11 out of a possible 17 times, the highest intakes for the year were recorded for autumn. On the other hand, instead of being third highest for the year, calorie intakes for the summer were actually the lowest of the four seasons in 11 out of 17 observation periods. The reason for this is difficult to determine. The children did not increase the amount used from season to season with the regularity and to the extent that might have been expected. For all but one of the children, calorie intakes increased during the second year, not to a great extent but enough to be significant.

Because the food intake of each of the children was observed during one week of each season for a 2-year period, it was considered worthwhile to assemble the food consumption figures according to ages. The youngest child for whom figures are herein reported was 19 months old at the beginning of the study. The oldest child was 61 months of age at the time of the last observation of food intake. Food consumption figures, computed according to age for all the children, are shown for 6-month intervals in Table 3 and for intervals of one year in Table 4. With the exception of the last interval, for which there is only one case, the total calorie intake increased fairly steadily with age. Using average food consumption figures from actual studies, two tables have been compiled, one showing total daily calorie intakes of moder-

TABLE 3.—Calorie Intake of Preschool Children at Intervals of 6 Months

Age Mos.	Number of cases	Average	Range	Per kilogram	Per inch	Per pound
18–23	6	1104	1001–1193	82.8	32.9	37.6
24–29	13	1196	972–1431	82.8	33.2	37.6
30–35	15	1245	953–1529	79.8	32.9	36.2
36–41	15	1281	1000–1501	77.7	32.6	35.2
42–47	8	1292	1154–1484	74.1	31.6	33.6
48–53	5	1334	1127–1597	78.3	32.2	35.5
54–59	3	1481	1419–1595	86.2	35.2	39.1
60–65	1	1360	1360	79.8	32.2	36.2

TABLE 4.—Calorie Intake of Preschool Children at Yearly Intervals

Age Mos.	Number of cases	Average	Range	Per kilogram	Per inch	Per pound
18–29	19	1167	972–1431	82.8	33.1	37.6
30–41	30	1263	953–1529	78.7	32.7	35.8
42–53	13	1308	1127–1597	75.7	31.9	34.4
54–65	4	1450	1360–1595	84.6	34.4	38.5

ately active, well-nourished girls and the other of well-nourished boys from 2 years of age on (29). These figures are shown for purposes of comparison in Table 5 and Figure 3. There is a reasonably close agreement for the two ages for which there are enough cases from this study to justify comparisons—namely, for years 2 to 3 and 3 to 4.

TABLE 5.—Calorie Intake of Nine Preschool Children as Compared to a Suggested Standard

Age Yrs.	Boys			Girls		
	Number of cases	This study	Standard*	Number of cases	This study	Standard*
1–2	4	1124	.....	2	1016	.....
2–3	16	1275	1192	12	1153	1222
3–4	13	1327	1348	10	1230	1268
4–5	4	1397	1510	4	1381	1455

*White House Conference on Child Health and Protection: Growth and Development of the Child. Part III, Nutrition. 1932. The Century Company, New York.

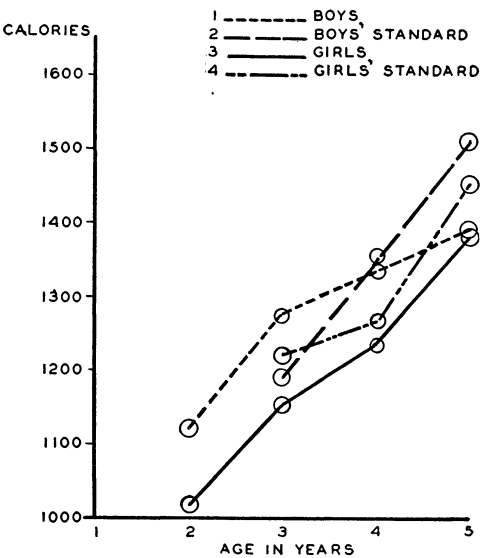

Fig. 3.—Calorie intake of preschool boys and girls as compared to a suggested standard

As shown in Table 3, although the range in calorie intake for each age group was large (especially for those ages for which the largest number of cases are given), the lowest, as well as the highest, calorie intakes increased fairly consistently with age.

When each week of observation of each child was considered as an individual case, since each child's age was different during each successive period, there were 66 records of food consumption of one week's time, a large enough number of cases to be treated statistically. Fisher's t formula (6),

designed for use with small samples, was used to determine the significance of the total calorie intake in regard to the various measures of development, such as age, weight, and height. Table 6 shows the results of the computations. As shown by this table, the greatest significance may be attached to the relationship between total calorie intake and height, although age, weight, and height data are all significant—that is, there is less than one chance out of a hundred that differences between the calorie intake of the two age groups selected are due to chance; the chances are still less in regard to weight and considerably less in regard to height.

TABLE 6.—Values of t When Calorie Intake is Referred to Age, Weight, and Height*

Intake	Age	Weight	Height
	18–41 months 42–65 months	12–16 kilograms 17–21 kilograms	82– 96 centimeters 97–111 centimeters
Total calories	2.940	3.905	4.888
Calories per kilogram	1.201	.....	2.452
Calories per inch	0.519	0.307	.....

*t of 2.576—less than one chance in 100 that the differences would be exceeded by chance.

In their observations of older girls from 8 to 17 years of age, Wait and Roberts (24) found a slightly higher correlation between total calories and height than for total calories and either age or weight. In this respect, the two sets of data are similar. However, the total calorie intake of the older girls was not "directly proportional to any one of the three common measures of stage of development, age, weight, and height." In this respect, the two sets of data differ in that age, weight, and height are all significant in regard to the total calorie intake of the younger children of this study, height being most significant of the three measures.

Preschool children are in a period in which growth is more rapid and probably more nearly uniform than is the case with older children. In addition, activity is more closely related to age in younger children than with older ones. Age would, therefore, be expected to have a greater influence upon calorie intake than was the case with the older children of the Wait and Roberts study.

CALORIES PER KILOGRAM

Considerable variation was shown in the number of calories per kilogram eaten by individual children during the four seasons of each year. Each child's average for the second year was slightly less than that of the first year.

The significance of age differences (see Table 6) was much less in regard to calories per kilogram than in regard to total calories and, also, much less than for the older girls of the Wait and Roberts study, in which the age differences were much greater than for the preschool children of this study.

Calories per inch remained remarkably uniform for individual children during the 2-year period and differed little among the children. On this basis, however, the group average of 33 calories per inch was somewhat below the suggested standard of from 35 to 37 calories per inch for preschool children. These data bear out the statement that each individual child has his own calorie need which may vary from that of others of the same age and size (29).

As shown by Table 6, calories per inch had no significant relationship to age or weight.

VARIATIONS IN CALORIE INTAKE

The study herein reported gives a detailed picture of the daily food habits of six children during one week of each season for a 2-year period and for three other children for a somewhat shorter period of time. Table 7, which gives the daily variation in the calorie intake of these children for each week of the observations, shows to what an extent calorie intakes vary from day to day, even for such young children.

TABLE 7.—Daily Variations in the Calorie Intake of Preschool Children

Season	1st day	2nd day	3rd day	4th day	5th day	6th day	7th day	Average
Child 1—Boy								
Summer, 1932	1091[7]	1055	1019	1225	1024	613	980	1001
Autumn, 1932	1235[2]	1231	1316	1112	1226	1409	1176	1244
Winter, 1933	1407[2]	1478	1244	1273	1434	780	1121	1248
Spring, 1933	1158[4]	1412	1462	1374	1128	1239	1465	1320
Summer, 1933	1108[5]	1345	1245	1239	1263	1124	1339	1238
Autumn, 1933	1508[7]	1160	1195	1302	1280	1378	1450	1325
Child 2—Boy								
Winter, 1932	1185[4]	1082	1116	1196	1233	1348	1099	1180
Spring, 1932								
Summer, 1932	1097[3]	1029	1034	986	1105	1180	1251	1097
Autumn, 1932	1355[3]	1392	1481	1385	1221	1451	1451	1391
Winter, 1933	1512[3]	1331	1164	1480	1492	1321	1597	1414
Spring, 1933	1285[4]	1090	1428	913	1288	1290	1091	1198
Summer, 1933	1367[4]	1242	1334	1205	1256	1356	1102	1266
Autumn, 1933	1386[7]	1845	1637	1321	1392	1053	1440	1439
Child 3—Boy								
Winter, 1932	1186[7]	1038	1248	1425	1149	1125	1088	1180
Spring, 1932	1120[3]	1062	1031	1346	1045	1252	985	1120
Summer, 1932	901[6]	1019	1113	1181	1049	936	1121	1046
Autumn, 1932	1358[7]	1191	995	1045	1183	1190	1476	1205
Winter, 1933	1122[2]	1123	1344	1392	1084	869	1438	1196
Spring, 1933	1198[4]	1378	1520	1117	1152	1231	1417	1288
Summer, 1933	1406[4]	1062	1111	1207	1171	1454	1111	1218
Autumn, 1933	1246[5]	1190	1312	1312	1502	999	1020	1226
Child 4—Girl								
Winter, 1932	1216[4]	1020	1030	952	1048	724	1162	1022
Spring, 1932	932[7]	1322	1024	1146	1083	1179	1079	1109
Summer, 1932	936[3]	936	975	1087	857	1036	975	972
Autumn, 1932	986[7]	1425	1068	1129	1379	1076	1169	1176
Winter, 1933	1071[3]	1219	973	1106	1197	788	680	1005
Spring, 1933	1172[4]	1242	1448	1058	1358	1213	1011	1215
Summer, 1933	1022[4]	1055	853	888	904	1164	1112	1000
Autumn, 1933	1136[7]	1522	1151	924	1566	1150	1027	1211
Child 5—Girl								
Winter, 1932	1129[3]	946	1038	1146	1239	836	1101	1062
Spring, 1932	1125[6]	1089	1182	1171	937	907	1164	1082
Summer, 1932	985[2]	949	964	972	798	1014	986	953
Autumn, 1932	1158[7]	1178	1097	1024	1294	1269	1161	1169
Winter, 1933	914[2]	805	946	1211	1005	1078	1157	1017

TABLE 7.—Daily Variations in the Calorie Intake of Preschool Children—Continued

Season	1st day	2nd day	3rd day	4th day	5th day	6th day	7th day	Average
Child 6—Girl								
Winter, 1932	1464[2]	1263	1239	1182	1303	878	1334	1238
Spring, 1932	1265[7]	1473	1462	1382	1576	1434	1423	1431
Summer, 1932	1404[3]	1399	1272	1188	1159	1172	1487	1297
Autumn, 1932	1188[7]	1364	1159	1247	1140	1232	1296	1232
Winter, 1933	1499[5]	1598	1326	1216	1458	1169	1358	1375
Spring, 1933	1675[2]	1594	1460	1454	1467	1308	1547	1501
Summer, 1933	1229[4]	1000	1442	1289	1094	1240	1341	1234
Autumn, 1933	1241[3]	1373	1471	1167	1168	1266	1565	1321
Child 7—Boy								
Winter, 1932	1494[2]	1584	1307	1309	1187	1202	1417	1357
Spring, 1932	1170[7]	1053	1389	950	1709	1077	1562	1273
Summer, 1932	1455[3]	1537	1775	1414	1982	1142	1399	1529
Autumn, 1932	1280[7]	1380	1132	1426	1536	1468	1467	1384
Winter, 1933	1400[2]	1493	1438	1393	1056	1376	1484	1377
Spring, 1933	1503[4]	1274	1439	993	971	1242	1410	1262
Summer, 1933	1926[4]	1453	1432	1332	1594	1319	1331	1484
Autumn, 1933	1440[7]	1869	1332	1681	1571	1511	1775	1597
Child 8—Boy								
Winter, 1932	1180[7]	1700	1060	1341	1314	1589	1259	1349
Spring, 1932	1735[7]	1401	1276	1254	1504	1631	953	1393
Summer, 1932	1098[3]	1157	1134	1169	1198	1232	1220	1172
Autumn, 1932	1437[7]	1583	1556	1121	1353	1434	1303	1398
Winter, 1933	1241[3]	1450	1485	1156	1326	1312	1160	1304
Spring, 1933	1058[4]	1476	1247	1290	.....	.....	.....	1268
Summer, 1933	1072[4]	1118	1037	1003	1305	1207	1149	1127
Autumn, 1933	1453[1]	1651	1378	1611	1586	1661	1824	1595
Child 9—Girl								
Winter, 1932	1554[2]	1279	1235	1263	1174	1205	1440	1307
Spring, 1932	960[7]	1372	999	1006	1564	1059	1295	1179
Summer, 1932	1131[3]	1173	1034	1205	1332	1152	1053	1154
Autumn, 1932	1406[7]	1336	1292	1059	1492	1418	1336	1334
Winter, 1933	1369[2]	1274	1408	1451	1270	1446	1182	1343
Spring, 1933	1395[2]	1372	1339	1445	1556	1150	1676	1419
Summer, 1933	1728[4]	1394	1432	1223	1375	1512	1330	1428
Autumn, 1933	1323[7]	1594	1278	1299	1384	1220	1421	1360

Key: Day of week observations were started. 1—Sunday, 2—Monday, 3—Tuesday, 4—Wednesday, 5—Thursday, 6—Friday, and 7—Saturday.

In Table 8, the maximum, as well as the minimum, calorie intake with the percentage difference, as based on the lowest intake, is shown for each child during each of the periods of observation. Figure 4 presents this material for the child having the least variation in calorie intake. Figure 5 represents the corresponding material for the child having the greatest variation in calorie intake.

Daily variations in the calorie intake of the entire group for the entire period averaged 43 per cent, as compared to a daily average variation of 49 per cent reported for 52 adolescent girls whose calorie intake was studied for one week's time by Wait and Roberts (25). For these older girls, the range of from 10 to 180.7 per cent in daily variation of calorie intake was much greater than that of the preschool children whose range was from 12 to 99.8 per cent.

TABLE 8.—Maximum and Minimum Calorie Intake of Preschool Children

Season	Maximum	Minimum	Difference	Per cent difference	Average
Child 1—Boy					
Summer, 1932	1225	613	612	99.8	1001
Autumn, 1932	1409	1112	297	26.7	1244
Winter, 1933	1478	780	698	89.5	1248
Spring, 1933	1465	1128	337	29.9	1320
Summer, 1933	1345	1108	237	21.4	1238
Autumn, 1933	1508	1160	348	30.0	1325
Child 2—Boy					
Winter, 1932	1348	1082	266	24.6	1180
Spring, 1932	.....	.....	.....	.....	.....
Summer, 1932	1250	986	264	26.8	1097
Autumn, 1932	1481	1221	260	21.3	1391
Winter, 1933	1597	1164	433	37.2	1414
Spring, 1933	1428	913	515	56.4	1198
Summer, 1933	1367	1102	265	24.0	1266
Autumn, 1933	1845	1053	792	75.2	1439
Child 3—Boy					
Winter, 1932	1425	1038	387	37.3	1180
Spring, 1932	1346	985	361	36.6	1120
Summer, 1932	1180	901	279	31.0	1046
Autumn, 1932	1476	995	481	48.3	1205
Winter, 1933	1438	869	569	65.6	1196
Spring, 1933	1520	1117	403	36.1	1288
Summer, 1933	1454	1062	392	36.9	1218
Autumn, 1933	1502	999	503	50.4	1226
Child 4—Girl					
Winter, 1932	1216	724	492	68.0	1022
Spring, 1932	1322	932	390	41.8	1109
Summer, 1932	1087	857	230	26.8	972
Autumn, 1932	1425	986	439	44.5	1176
Winter, 1933	1219	680	539	79.3	1005
Spring, 1933	1448	1011	437	43.2	1215
Summer, 1933	1164	853	311	36.5	1000
Autumn, 1933	1566	924	642	69.5	1211
Child 5—Girl					
Winter, 1932	1239	836	403	48.2	1062
Spring, 1932	1182	907	275	30.3	1082
Summer, 1932	1014	798	216	27.1	953
Autumn, 1932	1294	1024	270	26.4	1169
Winter, 1933	1211	805	406	50.4	1017
Child 6—Girl					
Winter, 1932	1464	878	586	66.7	1238
Spring, 1932	1576	1265	311	24.6	1431
Summer, 1932	1487	1159	328	28.3	1297
Autumn, 1932	1364	1140	224	19.6	1232
Winter, 1933	1598	1169	429	36.7	1375
Spring, 1933	1675	1308	367	28.1	1501
Summer, 1933	1441	1000	441	44.1	1234
Autumn, 1933	1565	1167	398	34.1	1321

TABLE 8.—Maximum and Minimum Calorie Intake of Preschool Children—Continued

Season	Maximum	Minimum	Difference	Per cent difference	Average
Child 7—Boy					
Winter, 1932	1584	1187	397	33.4	1357
Spring, 1932	1709	950	759	79.9	1273
Summer, 1932	1982	1142	840	73.6	1529
Autumn, 1932	1536	1132	404	35.7	1384
Winter, 1933	1493	1056	437	41.4	1377
Spring, 1933	1503	971	532	54.8	1262
Summer, 1933	1926	1319	607	46.0	1484
Autumn, 1933	1869	1332	537	40.3	1597
Child 8—Boy					
Winter, 1932	1700	1060	640	60.4	1349
Spring, 1932	1735	953	782	82.1	1393
Summer, 1932	1232	1098	134	12.2	1172
Autumn, 1932	1583	1121	462	41.2	1398
Winter, 1933	1485	1156	329	28.5	1304
Spring, 1933	1476	1058	418	39.5	1268
Summer, 1933	1305	1003	302	30.1	1127
Autumn, 1933	1824	1378	446	32.4	1595
Child 9—Girl					
Winter, 1932	1554	1174	380	32.4	1307
Spring, 1932	1564	960	604	62.9	1179
Summer, 1932	1332	1034	298	28.8	1154
Autumn, 1932	1492	1059	433	40.9	1334
Winter, 1933	1451	1182	269	22.8	1343
Spring, 1933	1676	1150	526	45.7	1419
Summer, 1933	1728	1223	505	41.3	1428
Autumn, 1933	1594	1220	374	30.7	1360

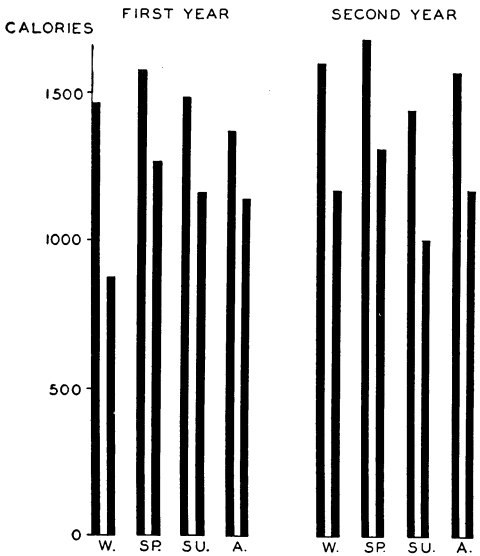

Fig. 4.—Maximum and minimum calorie intakes of child showing least daily variation

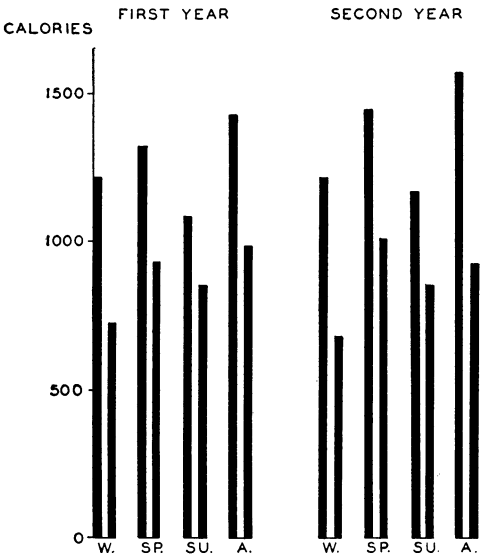

Fig. 5.—Maximum and minimum calorie intakes of child showing greatest daily variation

It is an interesting, and probably a significant, fact that with the preschool children, except when calorie intakes were unquestionably limited by some temporary indisposition such as a cold, the average daily variations were least for the younger children during the first year their diets were studied and increased the second year. On the other hand, corresponding variations were larger for the older children during the first year and decreased during the second year. This fact points to the conclusion that for young children there is a transition period from the time when the food habits are very closely supervised, little variety is offered, and the food resembles that of late infancy to the period when more variety is offered, the child is less closely supervised and has not yet become adjusted to the change. Later, as suggested by the data here presented, he becomes better adjusted and his calorie intake is, therefore, not so variable from day to day. Perhaps the transition period from the diet of infancy to that of the preschool child should be more gradual and the period of infancy should be one during which the child may have an opportunity to broaden his food experience to a greater extent than is now the custom. The experiments of Davis offer interesting suggestions in this respect (4).

There are probably a number of reasons why children vary the amount of food eaten from day to day. One day's food intake may affect that of the following day. In 10 of the 66 cases of the study herein reported, lowest calorie intakes immediately followed highest calorie intakes. In 13 cases, highest intakes immediately followed lowest intakes. Thus, for 35 per cent of the cases, highest calorie intakes either followed or preceded lowest calorie intakes. For the remainder of the cases, no such definite pattern was shown by the data. Wait and Roberts have noted that in 27.4 per cent of the cases they studied the day's food intake was influenced by that of the preceding day (25).

In some cases, the reasons for daily fluctuations in calorie intake are probably physiological. For two of the nine preschool children, unusually low intakes were associated with colds. With both these children, food intake returned to normal the second day. It has been frequently noted that a child who is in the initial stages of a cold loses his appetite and eats much less than is his custom, resuming his customary food intake as his condition becomes more nearly normal. Aldrich (1) considers loss of appetite in children a symptom to be reported to the physician as other symptoms are reported and also that many of the problems which arise in connection with anorexia in children may be attributed to the fact that parents, failing to realize this cause of loss of appetite, over-urge children to eat at such times and thereby establish a distaste for food which may cause difficulty later. If a child is not over-urged in regard to food intake at such a time, the appetite is likely to return to normal as the child's condition improves.

Excitement and emotional strain, undoubtedly, also influence a child's calorie intake. In two cases, low calorie intakes were associated with guest meals. In another case, extremely low calorie intake occurred just previous to a trip. The excitement incident to such occasions probably has an unfavorable effect upon children who are easily over-stimulated. One extremely low calorie intake was associated with a temper tantrum. A hurried breakfast caused the low calorie intake in another instance. These and other examples which might be cited from the data show the importance of so arranging the child's environment that conditions are favorable to his eating his meals quietly and without undue excitement.

The effect of food selection itself upon the calorie intake of children offers interesting possibilities. The menus served each of the children on the days of highest calorie intake and also on the days of lowest calorie intake have, therefore, been examined in regard to certain items of food. Although the number of cases is too small to make definite conclusions possible, certain trends are indicated.

Milk appeared in the diet of every child every day. In 52 cases the amount of milk used by a child as a beverage was higher on the day of his highest calorie intake than the amount used on the day of his lowest calorie intake for the week. These numbers, over three times the number of cases in which the largest amount of milk was used on the days of lowest calorie intake, are large enough to be significant. The safeguard that the habit of using milk as a beverage gives to children in regard to calorie intake is thereby emphasized.

The relationship of other foods to high or low calorie intakes is not so clear. The vegetable plate meals occurred more frequently on the days of lowest calorie intake than on days of highest calorie intake. It may be that the bulk of the vegetable meals was such as to cause an actual decrease in calorie intake, although when such meals were served in the nursery school high calorie desserts were usually served. It has been shown that adults tend to regulate by bulk the total calories consumed (7).

The relation of the use of meat, including poultry, muscle cuts, and liver, to days of highest and lowest calorie intake of the children is interesting. Bartlett *et al.* (2) have shown that such foods have a stimulating effect upon the appetite. In most cases, the amounts of these foods used by this preschool group were small, but the fact that liver appeared twice as often and meat once and a half times as often on days of highest calorie intake as on days of lowest calorie intake of a week is significant.

Many children do not eat fish readily, but the difference between the number of times it was in the menu on days of highest intake as compared to days of lowest intake is negligible. Surprisingly enough, this was also the case in regard to bacon, a food usually very acceptable to children.

Disregarding extremely low food intakes due to the effect of the physical condition of the child, as when colds were developing, greatest variations in calorie intake were found for children whose food included articles not usually considered suitable for children. In other words, when the bland, simple foods suited to children were served from day to day, the calorie intake varied less than when a greater variety of foods was permitted. In the interesting work of Davis (4) in which infants selected their own foods, it must be noted that all foods served were suited to the digestive capacity of the children, that no sugar or other sweets were used, and that no mixtures or combinations of food were given, a situation quite different from that which is found in the usual home when young children are allowed to select their foods from the family table.

Does the day of the week have an influence on calorie intake? As calculated from Table 7, a fairly definite trend seems apparent since the highest intakes in 14 cases appeared on Sunday, in 12 on Monday, and in 13 on Wednesday, highest intakes thus appearing more frequently at the beginning than at the end of the week. Saturday was the day on which lowest calorie intakes were also frequent, although lowest calorie intakes were also frequent on Tuesday, with Thursday and Friday next in order. Since most of the children were in nursery school during the week days, the school program would seem to be conducive to higher food intakes, although in 14 cases Sunday was the day of highest calorie intakes. During 4 of the 8 weeks his diet was studied, one child had his highest calorie intake on Sunday. Whether it had any special significance or not, Wednesday seemed a day favorable to highest calorie intakes. In 13 cases, highest calorie intakes appeared on that day, as compared to three when lowest calorie intakes appeared.

So many factors influence children in regard to food consumption that it is difficult to know which ones operate at specific times. During some period of the study each child attended nursery school. For such periods, calorie intakes have been computed for each child for the week-ends and also for the school days. Three of the five younger children had significant differences between calorie intakes for school days, as compared to calorie intakes for week-ends. For two of the three children, calorie intakes were higher during the week-ends than on school days. Both these children were newcomers to the nursery school and probably had not made a satisfactory adjustment to the school program at the time the food intake observations were made. The third child had the highest calorie intake during school days. Of the four older children, two had decidedly higher calorie intakes for school days than on week-ends, one had approximately the same, and a fourth averaged approximately 100 calories more on week-ends than during school days. Nevertheless, the total average calorie intake for the entire group for the entire period the children were in school failed to show any difference of moment between calorie intakes of school days and of week-ends.

The season seemed to influence variation in calorie intake with this small group of children. Five of the nine children averaged their greatest variation during the winter. The remaining four averaged their greatest variation during the spring, thus leaving summer and autumn as the seasons when the calorie intakes were most nearly uniform. Calorie intakes were highest for

six of the children during the autumn and were lowest for eight of the children during the summer, so that relative uniformity in calorie intake was thus associated with highest, as well as lowest, calorie intakes of the year and probably did not materially influence the average calorie intake.

Whatever the causes and whatever the significance, the preschool children studied showed a wide variation in calorie intake from day to day. The importance of using foods suitable for children and of so controlling the environment that emotional states do not disturb the daily rhythm of a child's living are of interest and suggest the need of further study of influences which cause such wide variations in calorie intakes of preschool children.

The daily variations in the calorie intake of one of the children have been discussed more fully elsewhere (12).

DISTRIBUTION OF CALORIES AMONG THE FOOD GROUPS

The distribution of the total calories used among the food groups has been suggested as a satisfactory method of evaluating the diets of children. The percentage of the total calories derived from each of the food groups has, therefore, been computed, and the material is presented in Tables 9 and 10 and in Figure 6.

Milk.—As a food, milk is of primary importance in the diets of children. It provides the largest part of the calcium of the diet, a generous proportion of the phosphorus and of vitamin A, as well as vitamin G, some vitamin B, protein of excellent quality, and calories in an easily digestible, acceptable form. In addition, such iron as milk does contain, although it is small in amount, is well utilized (20).

As shown by Table 9, the percentage of total calories contributed by milk varied among the children and for individual children from season to season, the range being from 23 to 51, with an average of 39 per cent for the first year. For the second year, the corresponding range was from 28 to 56, with

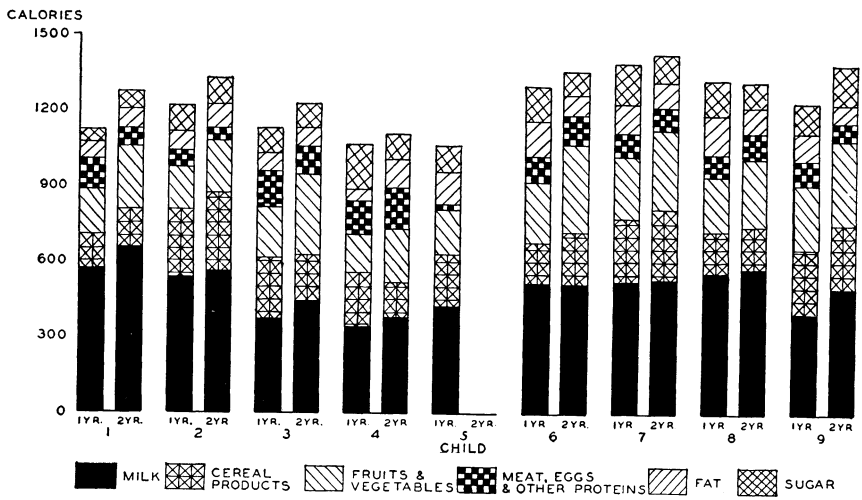

Fig. 6.—Distribution of calories among the food groups during each of two years

TABLE 9.—Average Daily Distribution of Calories Among the Food Groups

Season	Total calories	Milk Per cent	Cereal Per cent	Fruits and vegetables Per cent	Meat and eggs Per cent	Sugar Per cent	Fat Per cent
Child 1—Boy							
Summer, 1932	1001	51	8	18	12	7	5
Autumn, 1932	1244	51	15	15	10	6	4
Average	1122	51	12	16	11	6	4
Winter, 1933	1248	56	11	15	7	5	4
Spring, 1933	1320	51	13	18	5	6	8
Summer, 1933	1238	51	11	22	6	5	6
Autumn, 1933	1325	47	14	23	4	8	5
Average	1283	51	12	20	6	6	6
Child 2—Boy							
Winter, 1932	1180	41	26	12	7	7	5
Spring, 1932							
Summer, 1932	1097	50	17	12	7	4	8
Autumn, 1932	1391	42	23	14	4	8	8
Average	1223	44	22	13	6	6	7
Winter, 1933	1414	41	27	13	3	7	9
Spring, 1933	1198	35	26	19	5	7	8
Summer, 1933	1266	47	17	14	7	7	7
Autumn, 1933	1439	43	22	18	3	8	5
Average	1329	42	23	16	4	7	7
Child 3—Boy							
Winter, 1932	1180	30	29	18	10	2	11
Spring, 1932	1120	40	20	17	11	5	8
Summer, 1932	1046	29	22	15	19	10	6
Autumn, 1932	1205	32	14	24	10	11	8
Average	1138	33	21	18	12	7	8
Winter, 1933	1196	33	13	29	10	5	9
Spring, 1933	1288	39	15	25	7	6	8
Summer, 1933	1218	39	15	24	9	6	9
Autumn, 1933	1226	33	18	24	9	7	9
Average	1232	36	15	26	9	6	9
Child 4—Girl							
Winter, 1932	1022	23	26	16	10	3	21
Spring, 1932	1109	27	20	16	12	3	19
Summer, 1932	972	44	14	14	16	1	11
Autumn, 1932	1176	36	17	12	12	11	11
Average	1070	32	19	14	12	4	16
Winter, 1933	1005	31	15	17	15	12	10
Spring, 1933	1215	33	12	19	16	9	11
Summer, 1933	1000	41	11	19	16	5	8
Autumn, 1933	1211	30	15	20	12	12	10
Average	1108	34	13	19	15	10	10
Child 5—Girl							
Winter, 1932	1062	37	23	10	2	14	14
Spring, 1932	1082	40	20	18	1	9	12
Summer, 1932	953	48	13	16	3	11	9
Autumn, 1932	1169	37	18	21	4	13	7
Average	1066	40	18	16	2	12	10
Winter, 1933	1017	37	17	26	4	7	9

TABLE 9.—Average Daily Distribution of Calories Among the Food Groups—Continued

Season	Total calories	Milk	Cereal	Fruits and vegetables	Meat and eggs	Sugar	Fat
		Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
Child 6—Girl							
Winter, 1932	1238	33	10	22	11	14	10
Spring, 1932	1431	40	15	18	6	9	9
Summer, 1932	1297	47	12	18	9	6	9
Autumn, 1932	1232	42	15	14	8	10	11
Average	1300	40	13	18	8	10	10
Winter, 1933	1375	37	15	24	6	8	10
Spring, 1933	1501	36	15	27	6	6	10
Summer, 1933	1234	42	13	26	10	4	6
Autumn, 1933	1321	35	18	25	9	6	8
Average	1358	38	15	26	8	6	8
Child 7—Boy							
Winter, 1932	1357	34	17	21	8	7	14
Spring, 1932	1273	40	15	18	6	9	12
Summer, 1932	1529	41	15	18	8	8	10
Autumn, 1932	1384	36	23	17	7	7	10
Average	1386	38	18	18	7	8	12
Winter, 1933	1377	31	22	24	7	6	10
Spring, 1933	1262	36	21	23	5	7	8
Summer, 1933	1484	47	13	18	5	9	8
Autumn, 1933	1597	35	22	24	6	7	7
Average	1430	37	20	22	6	7	8
Child 8—Boy							
Winter, 1932	1349	42	12	15	5	13	12
Spring, 1932	1393	39	14	17	7	10	12
Summer, 1932	1172	44	11	16	7	10	11
Autumn, 1932	1398	44	14	15	8	10	9
Average	1328	42	13	16	7	11	11
Winter, 1933	1304	42	14	18	8	9	8
Spring, 1933	1268	44	11	21	6	9	8
Summer, 1933	1127	45	12	19	10	7	8
Autumn, 1933	1595	43	14	23	6	6	8
Average	1324	44	13	20	8	8	8
Child 9—Girl							
Winter, 1932	1307	24	23	22	11	8	12
Spring, 1932	1179	36	16	24	8	9	7
Summer, 1932	1154	32	23	21	5	9	11
Autumn, 1932	1334	36	20	18	6	9	11
Average	1244	32	20	21	8	9	10
Winter, 1933	1343	28	22	25	5	6	14
Spring, 1933	1419	38	19	22	4	5	11
Summer, 1933	1428	35	19	24	6	6	10
Autumn, 1933	1360	43	14	23	6	6	8
Average	1388	36	18	24	5	6	11

an average of 40 per cent; the average amount used thus showed a slight increase. With the exception of one child, average yearly percentages varied little for individual children in the 2-year period.

TABLE 10.—Average Distribution of Calories Among the Food Groups for a 2-year Period

Food	First year			Second year			Standard*
	Range	Average	Median	Range	Average	Median	
	Pct.	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
Milk	32—51	39	40	34—51	40	38	45—55
Cereals	12—22	17	18	12—23	16	15	18—20
Fruits and vegetables	13—21	17	16	16—26	22	21	16—22
Meat	2—9	4	4	3—8	4	4	3—5
Egg	1—7	4	4	2—7	4	3	
Sugar	4—12	8	8	6—10	7	6	1—3
Fat	4—16	10	10	6—10	8	8	4—8

*Rose, M. S., E. Robb, and G. M. Borgeson. 1932. Food Consumption of Nursery School Children. Child Development 3: 29.

The amount of calcium in the diet is dependent largely upon the amount of milk used and for young children whose calorie intake is usually limited, milk should provide a generous proportion of the calories. For 12 of the 66 cases, from 45 to 55 per cent of the total calories was derived from milk. This is the amount of the tentative standard for preschool children suggested by Rose (17).

In 40 of the 66 cases, the children averaged from 0.95 to one gram of calcium daily, an amount considered adequate. In 23 cases, the average daily calorie intake was below 1200 calories. For 21 of these cases, the calcium provision was inadequate when less than 50 per cent of the total calories was provided through milk.

On the other hand, children who were averaging from 1200 to 1300 calories daily were adequately supplied with calcium when approximately 40 per cent or more of the calories were provided by milk. Those children who averaged 1300 calories or more daily had the amount of calcium suggested as standard when milk provided 35 per cent or more of these calories.

Phosphorus intake for the children, in the main, rather closely paralleled the calcium intake (the provision for phosphorus being somewhat more liberal than the provision for calcium) but was dependent, as in the case of calcium, largely upon the amount of milk in the diet.

As a group, the children averaged the lowest percentage of total calories from milk in the winter, the largest percentage in the summer, and little difference between the percentages so derived in spring and autumn.

Cereal foods.—Cereal products are valuable as sources of energy. They also contribute protein. The whole grain cereals are also serviceable in providing phosphorus, iron, and vitamin B.

Graham or entire wheat bread was used in the nursery school for the sandwiches which were served at the noon meal. Rolled oats and other cereal breakfast foods containing the greater part of the grain were used frequently in the home, the use of the highly-milled and the ready-to-eat cereal products being the exception rather than the rule.

As shown by Table 9, the percentage of total calories provided by the cereal grains varied from 8 to 29, with an average of 17 per cent for the first year. The average remained approximately the same for the second year, with a slight change in the range (11 to 27). This group of children was, therefore, having somewhat less than the tentative standard of from 18 to 20 per cent of total calories provided by cereals as suggested by Rose (17).

Although the individual children varied in the amount of cereal they ate from season to season in each of the 2 years, there was a remarkable uniformity in the average percentage of total calories derived from cereal grains for each of the 2 years for most of the children. In only two cases was there a difference greater than 2 per cent between the 2 years. Two children each had 6 per cent fewer calories from cereal products during the second than during the first year.

For children whose percentage of total calories derived from cereal products is as low as was found in this group, this uniformity in regard to total calories derived from cereal products suggests a pattern which is probably desirable for such children, in that it indicates the desirability of keeping the use of cereal products relatively uniform. As the child's food habits change to include a larger percentage of calories from fruits and vegetables, these data suggest that this increase need not be at the expense of calories derived from cereal grains. For children who are having a large percentage of calories derived from cereal, undoubtedly these should be decreased as fruits and vegetables are added to the diet in increasing amounts.

The average percentage of total calories derived from cereal grains for the entire group varied little among the seasons, except during the summer when this percentage reached its lowest point. At the same time, the average calorie intake for the summers was less than that of any of the other seasons. It would seem desirable, therefore, to keep the cereal content of the diet fairly uniform for children of this economic level.

Fruits and vegetables.—As the preschool child's habits change from the rather restricted diet of infancy, the use of fruits and vegetables increases. These foods are important from the standpoint of providing for the child's needs at the time and also from the standpoint of habit formation.

For the entire group of children, the range in terms of percentage of total calories derived from fruits and vegetables was from 10 to 29 per cent, both extremes being found among the younger children. As might be expected, however, the younger group averaged a somewhat lower percentage of total calories from vegetables and fruits than did the older group.

Every child in the entire group ate more fruits and vegetables during the second than during the first year. The average percentage of total calories provided by fruits and vegetables remained surprisingly constant from season to season—the smallest average, 18 per cent, being in the summer, followed by 19 per cent each for autumn and winter, and 20 per cent for the spring. The fact that the modern market has almost eradicated season, as far as the availability of fruits and vegetables throughout the year is concerned, is reflected in the food habits of these children.

As with the cereal products, the season when the lowest percentage of total calories was derived from fruits and vegetables was the season of lowest average calorie intake during both years of the study, and in both cases the season was summer.

Meat and eggs.—These foods are usually grouped together, but, because they are each quite distinctive in their contribution to the diet, they have also been considered separately in this report and the percentage of total calories derived from them as a group, as well as from each one individually, has been determined. The percentage of total calories derived from meat and eggs was relatively high for the group of children studied, the range being from one to 19 per cent for the four seasons of the first year, with an average of 8 per cent for the group for the entire year. During the second year, the range was

from 3 to 16 with an average unchanged from that of the first year. The percentage of total calories derived from meats and eggs was, therefore, decidedly higher than the suggested standard of from 3 to 5 per cent (17).

Meat.—Some difference of opinion exists as to the value of meat in the diet of young children. In her work with self selection of diet by newly-weaned infants, Davis reports children using from 9.2 to 13.3 per cent (average 11.2) of total calories from meat and for the period of the study growing satisfactorily and maintaining good physical condition (4). As shown by percentage of total calories derived from meat, its use varied in the present study from 1 to 12 per cent during the seasons of the first year, with an average of 4 per cent for the entire group. The range for the second year was from 1 to 9, with an average of 4. Percentages remained remarkably consistent among the seasons, averaging 4 per cent each for spring, summer, and autumn and 5 per cent for the winter.

Eggs.—Eggs reinforce the diet in regard to protein, as well as in regard to iron, phosphorus, and vitamins A, B, and G, and are, therefore, of importance in the diet of young children. Eggs provided from less than 1 to 8 per cent of the total calories of the diet during the seasons of the first year, with a yearly average for the group of 4 per cent. The average remained unchanged during the second year, with a range of from 1 to 10 per cent. The average percentage of total calories provided by eggs was somewhat higher during the summer than during the other seasons.

Sugar.—In contrast to other food classes which contribute factors essential to growth and development of the child, as well as providing calories, sugar contributes nothing to the diet but calories (19). For this reason, its use should be limited. For this group of preschool children, the calories derived from sugar ranged from 1 to 14 during the seasons, with an average of 8 per cent for the first year. During the second year, the average was 7 per cent, with a range of from 4 to 12 per cent. The tentative suggested standard of Rose is that from 1 to 3 per cent of total calories be derived from sugar (17).

One child increased the amount of sugar used the second year, four children used approximately the same amount during both years, and three children decreased the per cent used. This would seem to indicate that the habit of the use of sugar was decreasing rather than increasing with this small group of children.

Fat.—The calories derived from fat ranged from 4 to 21 per cent among individual children during the four periods of observation of the first year, with an average of 10 per cent for the entire group. During the second year, the corresponding range was from 4 to 14 per cent, with a group average of 8 per cent. As seen by Table 9, for all but one of the children, the average fat intake was not far from the upper limit of the standard of from 4 to 8 per cent of total calories to be derived from fat, as suggested by Rose.

It is probably of significance that the child whose average fat intake was highest, as shown by the percentage of total calories provided by fat, was the child whose calorie intake was the lowest of the entire group for the 2-year period. The depressing effect of an excess of fat in the diet on the appetite of children has been stressed by several writers (1, 17, 29).

Table 10 shows the range, the average, and the median percentage of total calories contributed by each food group for each of the years, as well as the standard suggested by Rose.

CALORIES DERIVED FROM PROTEIN, FAT, AND CARBOHYDRATES

It is sometimes assumed that, in the main, the distribution of calories among the three foodstuffs, protein, fat, and carbohydrate, should follow a general pattern for young children. Holt's standard of protein (15 per cent), fat (35 per cent), and carbohydrates (50 per cent) has been generally accepted (8). As shown by Table 11 and Figure 7, the intakes deviate from this pattern in all but one case. When average figures for individual children were considered for each of the 2 years, it was seen that for eight out of 17 instances the percentage of calories derived from carbohydrates was higher than the standard; for nine, the percentage of calories derived from fat was above the standard; whereas in only two instances was the percentage of calories derived from protein more than the suggested 15 per cent.

Only one child had a much higher proportion of fat in her diet than the suggested 35 per cent. It is interesting and probably significant that this child's calorie intake was consistently lower than the others of the same age. As suggested before, one of the causes of anorexia is a diet with a high fat content.

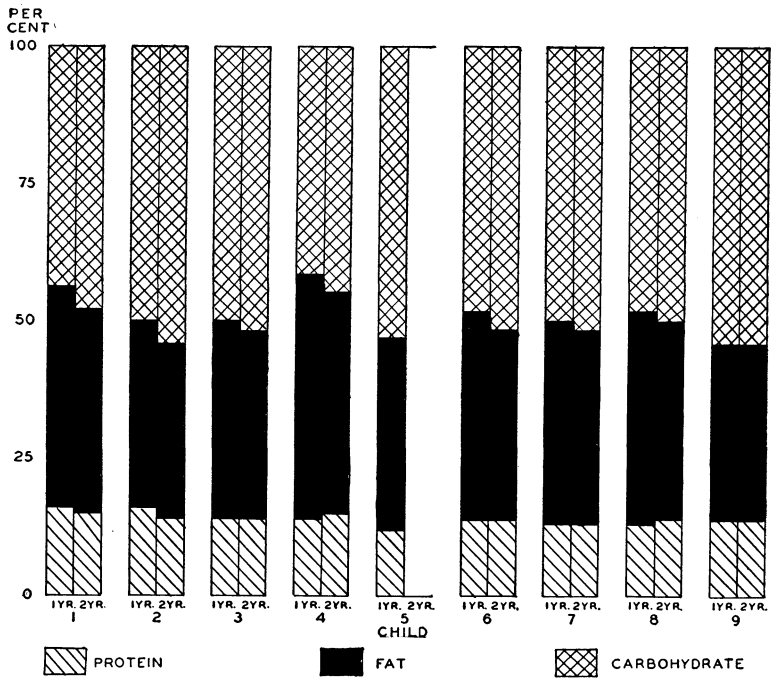

Fig. 7.—Percentage of calories derived from protein, fat, and carbohydrate during each of two years

TABLE 11.—Percentage of Calories Derived from Protein, Fat, and Carbohydrate

	Child 1			Child 2			Child 3			Child 4			Child 5			Child 6			Child 7			Child 8			Child 9		
	Pro.	Fat	Carb.	Pro.	Fat	Carb.	Pro.	Fat	Carb.	Pro.	Fat	Carb.	Pro.	Fat	Carb.	Pro.	Fat	Carb.	Pro.	Fat	Carb.	Pro.	Fat	Carb.	Pro.	Fat	Carb.
Winter, 1932...	.....	....	.....	15	34	51	14	37	49	12	43	45	12	36	52	13	35	52	12	38	50	12	39	48	13	34	54
Spring, 1932...	.....	....	.....	.....	....	.....	14	38	48	13	43	44	12	36	52	14	38	49	13	36	51	13	39	48	14	32	54
Summer, 1932..	17	40	43	18	33	49	15	37	48	16	48	36	12	36	52	16	39	45	14	38	48	13	40	47	13	31	56
Autumn, 1932.	16	39	45	14	34	52	12	34	54	14	40	46	12	31	57	14	40	46	13	36	51	14	38	48	14	33	53
Average for first year....	16	40	44	16	34	51	14	36	50	14	44	43	12	35	53	14	38	48	13	37	50	13	39	48	14	32	54
Winter, 1933...	16	39	45	14	34	52	13	33	54	13	39	48	12	32	56	14	34	52	12	34	54	14	35	51	13	30	57
Spring, 1933...	15	38	47	14	29	57	14	34	52	15	41	44	.....	....	.....	13	33	54	13	34	53	13	38	49	13	35	52
Summer, 1933..	15	37	48	15	34	51	14	36	50	17	41	42	.....	....	.....	15	35	50	14	40	46	15	38	47	14	32	54
Autumn, 1933.	14	33	53	14	32	54	13	34	53	14	37	49	.....	....	.....	15	32	53	14	32	54	13	34	53	15	33	52
Average for second year..	15	37	48	14	32	54	14	34	52	15	40	46	.....	....	.....	14	34	52	13	35	52	14	36	50	14	32	54
Average for two years....	16	38	47	15	33	52	14	35	51	14	42	44	12	34	54	14	36	50	13	36	51	13	38	49	14	32	54

PROTEIN INTAKE OF PRESCHOOL CHILDREN

Observations of the actual food consumption of normal healthy children have been generally accepted as the best procedure to establish energy requirements for children of the preschool age (5). The amount of protein eaten, however, is of less value in determining protein requirements, because, although the protein intake should provide for growth as well as for maintenance, there are other factors which also affect growth. Nevertheless, the amount of protein eaten by healthy children who are gaining at the expected rate or better would seem to be at least "indicative of good practice" (26).

Summaries of the results of protein balance experiments with children, as well as the protein intake as shown in dietary studies, have been given by Wait and Roberts (26) and by McKay and Evans (14) and will not be repeated here.

The findings in regard to the protein intake of the preschool children of the study herein reported follow.

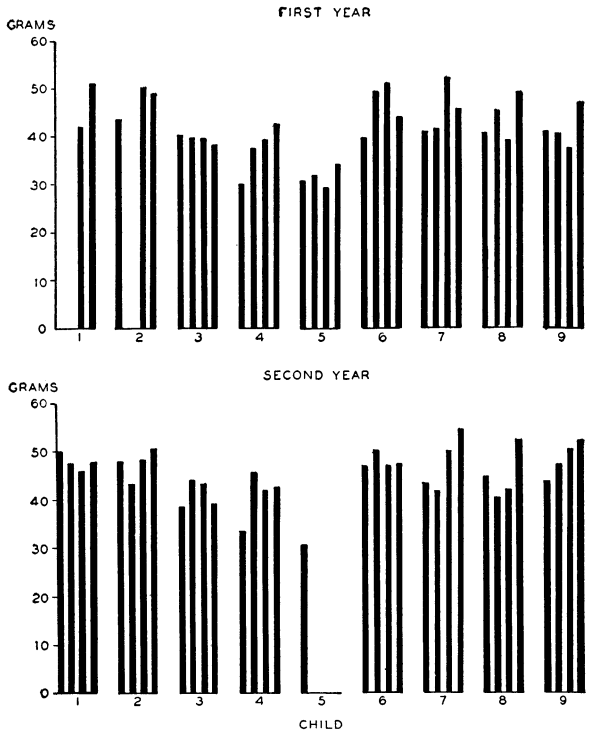

Fig. 8.—Seasonal variation in protein intake of individual preschool children during each of two years

TABLE 12.—Protein Intake of Preschool Children

Season	Total grams of protein	Grams per kilogram	Grams per centimeter	Per cent of total calories	Average calorie intake
Child 1—Boy					
Summer, 1932	42.2	3.29	0.47	17	1001
Autumn, 1932	51.3	3.66	0.55	16	1244
Average for first year	46.8	3.48	0.51	16	1122
Winter, 1933	50.4	3.47	0.53	16	1248
Spring, 1933	47.7	3.11	0.49	15	1320
Summer, 1933	46.4	3.07	0.47	15	1238
Autumn, 1933	47.7	2.93	0.47	14	1325
Average for second year	48.0	3.14	0.49	15	1283
Child 2—Boy					
Winter, 1932	43.8	3.30	0.51	15	1180
Spring, 1932	.....	.....	.....	.....	.....
Summer, 1932	50.3	3.36	0.54	18	1097
Autumn, 1932	48.8	3.26	0.52	14	1391
Average for first year	47.6	3.31	0.52	16	1223
Winter, 1933	48.6	3.10	0.50	14	1414
Spring, 1933	43.5	2.74	0.44	14	1198
Summer, 1933	48.3	2.92	0.48	15	1266
Autumn, 1933	51.0	3.02	0.50	14	1439
Average for second year	47.8	2.94	0.48	14	1329
Child 3—Boy					
Winter, 1932	40.8	2.96	0.49	14	1180
Spring, 1932	39.7	2.78	0.47	14	1120
Summer, 1932	39.4	2.76	0.45	15	1046
Autumn, 1932	38.2	2.61	0.42	12	1205
Average for first year	39.5	2.78	0.46	14	1138
Winter, 1933	38.6	2.50	0.42	13	1196
Spring, 1933	44.1	2.74	0.46	14	1288
Summer, 1933	43.6	2.66	0.45	14	1218
Autumn, 1933	39.1	2.23	0.39	13	1226
Average for second year	41.4	2.53	0.43	14	1232
Child 4—Girl					
Winter, 1932	30.4	2.38	0.37	12	1022
Spring, 1932	37.8	2.89	0.44	13	1109
Summer, 1932	39.8	3.00	0.46	16	972
Autumn, 1932	42.7	3.08	0.47	14	1176
Average for first year	37.7	2.84	0.44	14	1070
Winter, 1933	33.5	2.28	0.36	13	1005
Spring, 1933	46.4	2.95	0.49	15	1215
Summer, 1933	42.1	2.60	0.43	17	1000
Autumn, 1933	42.8	2.75	0.44	14	1211
Average for second year	41.2	2.64	0.43	15	1108
Child 5—Girl					
Winter, 1932	31.3	2.61	0.36	12	1062
Spring, 1932	32.4	2.59	0.37	12	1082
Summer, 1932	29.6	2.32	0.33	12	953
Autumn, 1932	34.8	2.60	0.37	12	1169
Average for first year	32.0	2.53	0.36	12	1066
Winter, 1933	31.7	2.25	0.33	12	1017

TABLE 12.—Protein Intake of Preschool Children—Continued

Season	Total grams of protein	Grams per kilogram	Grams per centimeter	Per cent of total calories	Average calorie intake
Child 6—Girl					
Winter, 1932	39.9	2.50	0.43	13	1238
Spring, 1932	49.3	2.99	0.54	14	1431
Summer, 1932	52.0	3.05	0.55	16	1297
Autumn, 1932	44.1	2.45	0.45	14	1232
Average for first year	46.3	2.75	0.49	14	1300
Winter, 1933	47.2	2.51	0.47	14	1375
Spring, 1933	50.1	2.52	0.49	13	1501
Summer, 1933	47.4	2.36	0.45	15	1234
Autumn, 1933	47.6	2.29	0.44	15	1321
Average for second year	48.1	2.42	0.46	14	1358
Child 7—Boy					
Winter, 1932	41.0	2.48	0.42	12	1357
Spring, 1932	42.0	2.50	0.43	13	1273
Summer, 1932	52.4	3.00	0.52	14	1529
Autumn, 1932	46.6	2.63	0.45	13	1384
Average for first year	45.5	2.65	0.46	13	1386
Winter, 1933	43.7	2.36	0.42	12	1377
Spring, 1933	42.1	2.16	0.40	13	1262
Summer, 1933	50.6	2.53	0.47	14	1484
Autumn, 1933	54.7	2.71	0.49	14	1597
Average for second year	47.8	2.44	0.44	13	1430
Child 8—Boy					
Winter, 1932	41.0	2.75	0.42	12	1349
Spring, 1932	46.0	3.06	0.47	13	1393
Summer, 1932	39.2	2.49	0.39	13	1172
Autumn, 1932	49.5	2.95	0.48	14	1398
Average for first year	43.9	2.81	0.44	13	1328
Winter, 1933	45.4	2.65	0.44	14	1304
Spring, 1933	40.9	2.29	0.38	13	1268
Summer, 1933	42.4	2.31	0.39	15	1127
Autumn, 1933	52.5	2.60	0.47	13	1595
Average for second year	45.3	2.46	0.42	14	1324
Child 9—Girl					
Winter, 1932	41.5	3.08	0.44	13	1307
Spring, 1932	41.1	3.05	0.43	14	1179
Summer, 1932	37.6	2.68	0.39	13	1154
Autumn, 1932	47.3	3.24	0.47	14	1334
Average for first year	41.9	3.01	0.43	14	1244
Winter, 1933	44.1	2.90	0.44	13	1343
Spring, 1933	47.4	3.08	0.46	13	1419
Summer, 1933	50.9	3.11	0.48	14	1428
Autumn, 1933	52.4	3.08	0.49	15	1360
Average for second year	48.7	3.04	0.47	14	1388

For the four seasons of the first year, the average daily protein intake among individual children ranged from 30 to 52 grams, with a daily average of 42 grams for the entire group for the year. Corresponding figures for the second year were from 32 to 55, with an average of 46 grams. (See Table 12

and Figure 8.) The average total amount of protein eaten by the group was, therefore, somewhat larger for the second than for the first year. This was true for each individual as well as for the entire group. For the entire group, the increase in total protein intake for the second year was 10 per cent, as compared to a corresponding increase of 7 per cent for total calorie intake. As they grew older, these children increased their protein intake slightly more than they increased their calorie intake. (See Table 13 and Figure 9.)

TABLE 13.—Average Protein Intake of Preschool Children

Child	Winter		Spring		Summer		Autumn	
	Total	Per Kg.	Total	Per Kg.	Total	Per Kg.	Total	Per Kg.
First year								
1	.....	.....	.....	.....	42.2	3.29	51.3	3.66
2	43.8	3.30	.....	.....	50.3	3.36	48.8	3.26
3	40.8	2.96	39.7	2.78	39.4	2.76	38.2	2.61
4	30.4	2.38	37.8	2.89	39.8	3.00	42.7	3.08
5	31.3	2.61	32.4	2.59	29.6	2.32	34.8	2.60
6	39.9	2.50	49.3	2.99	52.0	3.05	44.1	2.45
7	41.0	2.48	42.0	2.50	52.4	3.02	46.6	2.63
8	41.0	2.75	46.0	3.06	39.2	2.49	49.5	2.95
9	41.5	3.08	41.1	3.05	37.6	2.69	47.3	3.24
Second year								
1	50.4	3.47	47.7	3.11	46.4	3.07	47.7	2.93
2	48.6	3.10	43.5	2.74	48.3	2.92	51.0	3.02
3	38.6	2.50	44.1	2.74	43.6	2.66	39.1	2.23
4	33.5	2.28	46.4	2.95	42.1	2.60	42.8	2.75
5	31.7	2.25	.....	.....	.....	.....	.....	.....
6	47.2	2.51	50.1	2.52	47.4	2.36	47.6	2.29
7	43.7	2.36	42.1	2.16	50.6	2.53	54.7	2.71
8	45.4	2.65	40.9	2.29	42.4	2.31	52.5	2.60
9	44.1	2.90	47.4	3.08	50.9	3.11	52.4	3.08

The two youngest children averaged a slightly higher protein intake than any of the other children, although for six of the group the range in average daily protein intake was only from 45 to 48 grams for the 2-year period.

Statistical treatment of the data concerning protein intake, as referred to age, showed no significant relationship between the two (Table 14). For children of this age level, age in itself appeared to offer a poorer basis for predicting the protein needs of children than it did for predicting their calorie needs.

When total protein intake was considered in connection with weight, a significant relationship was shown statistically, as indicated by a value for t of 3.264. As referred to height, the value of t was 3.645, indicating a somewhat greater significance. With their larger group of individual girls and with an age range of from 8 to 17 years, Wait and Roberts found coefficients of correlation between protein intake and the three bases "commonly used in prediction"—age, weight, and height—lowest for age, second for weight, and highest for height, but they consider none of the coefficients of correlation high enough to be significant. With these younger preschool children of a decidedly more limited range in age, the findings were paralleled, except that the values of t for weight and height were large enough to be significant.

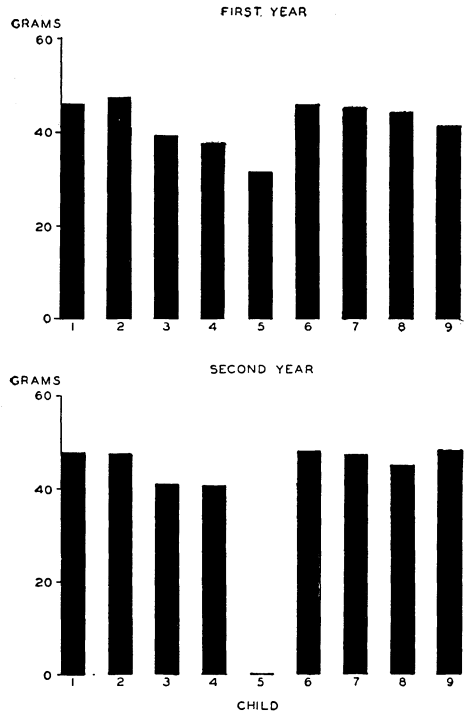

Fig. 9.—Average protein intake of individual preschool children for each of two years

TABLE 14.—Values of t When Protein Intake is Referred to Age, Weight, Height, and Calorie Intake*

Intake	Age	Weight	Height	Calorie intake
	18–41 mos. 42–65 mos.	12–16 kgs. 17–21 kgs.	82– 96 cms. 97–111 cms.	950–1274 1275–1600
Total protein	2.386	3.264	3.645	5.730
Protein per kg.	1.008	.....	2.220	.....

*t of 2.576—less than one chance in 100 that the differences would be exceeded by chance.

Protein per kilogram ranged among individual children from 2.32 to 3.66 for the four seasons of the first year, with a yearly average of 2.86 grams (Figure 10). For the second year, the corresponding range was from 2.16 to 3.45, with an average of 2.69 grams, figures which differ little from those of the first year. For one child, the amount eaten per kilogram was approximately the same for both years. Although the other children all decreased the amount taken per kilogram the second year, the decreases are not comparable to decreases in protein intake per kilogram with increased age, as reported for the older girls of Wait and Roberts.

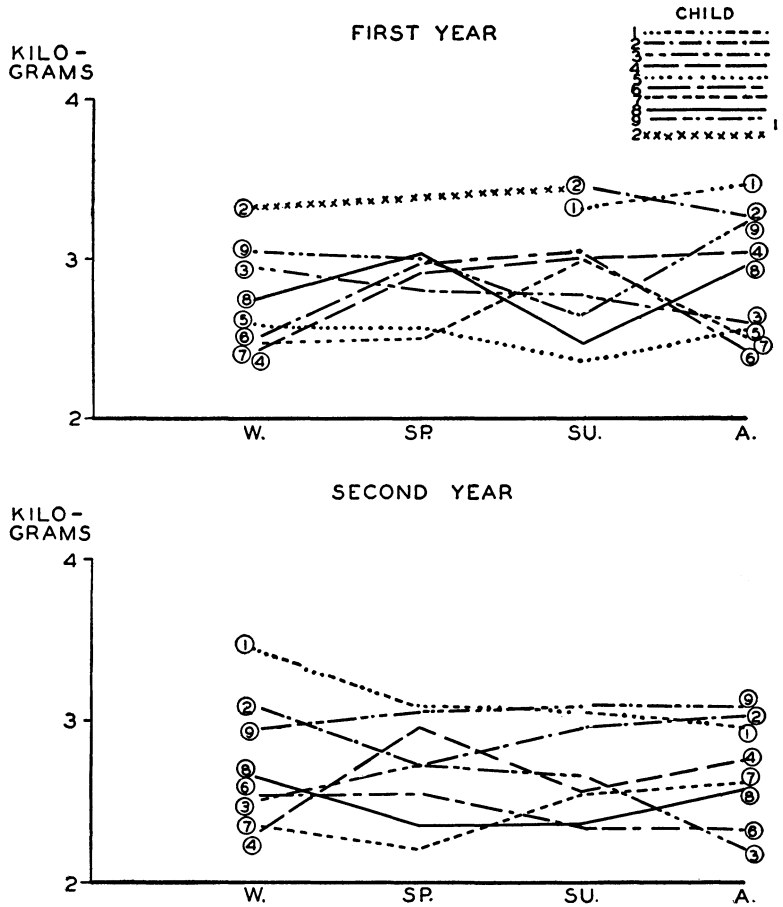

Fig. 10.—Average protein intake per kilogram of preschool children during each season of the two-year period

[1]xxx Indicates time child was out of city.

Statistical treatment of the data, giving a value for t of 1.008, showed no significant relationship in regard to age. For these children, the significance of age differences was leveled out when the protein intake was put upon the kilogram basis.

Although protein per kilogram, as referred to height, gave a higher value for t than did protein per kilogram referred to age, the value, 2.220, was too low to be of significance.

For the group as a whole, 14 per cent of the total calories was derived from protein during each of the 2 years. For the first year, the amount eaten during the seasons by individual children ranged from 12 to 18 per cent. The corresponding range for the second year was from 12 to 17 per cent. These figures indicate the consistency of the relation between protein intake and total calories. This relationship is also shown by the value of t (5.730). The

suggestion of Sherman that from 10 to 15 per cent of total calories should be derived from protein is substantiated by the findings of this study, although for these young preschool children the average was nearer the upper than the lower amount. The preschool years are years of rapid growth and the protein need is correspondingly high.

Table 15 and Figure 11 indicate the sources of the protein used by the nine preschool children during the period their diets were observed. During the four seasons of the first year, milk provided from 37 to 70 per cent, with an average for the year of 54 per cent of the total protein eaten. For the second year, the range decreased (39 to 66), but the average remained approximately the same, 53 per cent. During the first year, there were 33 cases of observation of the food intake for a week's time. In 12 of these cases, milk provided less than half the protein used. For the remaining 21 cases, milk provided one-half or more of the protein. During the second year with a similar number of cases, the corresponding figures were 10 and 23. Considering the entire period of the study, milk provided an average of less than half the protein eaten by two children only. The remaining seven children all averaged 50 per cent or more of their protein from milk. These figures indicate the importance of milk in the diets of children from the standpoint of protein provision. The value of this protein from the standpoint of quality has been shown by many studies.

Eggs and meat provide protein of excellent quality. During the first year of the study, these foods provided an average of 20 per cent of the protein used by individual children during the 4 weeks of observation, with a range of from 5 to 38 per cent. For the second year, the average remained unchanged, with the range from 8 to 42 per cent. The habit of individual children in regard to the proportion of the total protein provided by meat and eggs varied to a greater extent than did their habits in regard to milk.

During the entire period of the study, two children, for one week each, had a somewhat higher percentage of their protein from meat and eggs than from milk. In all the other cases, the percentage of protein from milk was decidedly greater than the proportion from meat and eggs.

Although cereal products are not considered as protein-rich foods, the fact that they are used in liberal amounts means that they form an important source of protein in the diet. When supplemented by the proteins of milk, the cereals are advantageously used. For the first year of the study, the percentage of protein provided by cereal products ranged from 6 to 30, with an average of 17 per cent. Corresponding figures for the second year were 8 to 24, with an average of 15 per cent.

The greater part of the protein in the diets of this group of preschool children was provided by milk, meat and eggs, and cereal products. Vegetables provided a smaller, but not inconsiderable, proportion of the protein—ranging from 3 to 11 per cent, with an average of 6 per cent for the first year, and from 4 to 11 per cent, with an average of 7 per cent for the second year.

Fruit provided a still smaller percentage of the total protein, increasing from an average of 2 per cent for the entire group for the first year to a corresponding average of 4 per cent for the second year.

TABLE 15.—Percentage of Protein Derived from Various Food Groups

Season	Milk	Cereal	Vegetable	Fruit	Meat and eggs	Fat (by difference)
Child 1—Boy						
Summer, 1932	58.25	6.19	8.06	1.11	26.25	0.15
Autumn, 1932	58.79	11.62	3.42	1.98	21.55	2.64
Average for first year	58.52	8.90	5.74	1.54	23.90	1.40
Winter, 1933	65.87	7.80	6.34	2.16	17.75	0.09
Spring, 1933	64.40	12.55	6.13	2.15	14.48	0.98
Summer, 1933	64.58	9.16	5.21	4.43	16.00	0.62
Autumn, 1933	62.62	12.82	7.13	4.96	12.08	0.39
Average for second year	64.37	10.58	6.20	3.42	15.08	0.52
Child 2—Boy						
Winter, 1932	54.23	20.57	6.29	0.96	17.74	0.21
Spring, 1932						
Summer, 1932	68.77	11.85	3.54	0.86	14.86	0.11
Autumn, 1932	61.68	20.25	3.47	2.11	10.38	2.11
Average for first year	61.56	17.56	4.43	1.31	14.33	0.81
Winter, 1933	61.80	22.79	4.37	2.22	7.52	1.30
Spring, 1933	57.94	20.33	4.02	3.24	13.25	1.22
Summer, 1933	60.82	13.71	4.77	2.54	17.73	0.42
Autumn, 1933	60.84	18.75	7.11	2.44	10.23	0.64
Average for second year	60.35	18.90	5.07	2.61	12.18	0.90
Child 3—Boy						
Winter, 1932	42.21	29.03	4.36	2.12	22.24	0.04
Spring, 1932	52.34	20.56	4.29	2.49	19.98	0.34
Summer, 1932	37.03	18.64	3.24	2.54	38.35	0.19
Autumn, 1932	48.72	15.69	5.22	4.51	24.64	1.22
Average for first year	45.08	20.98	4.28	2.92	26.30	0.45
Winter, 1933	50.35	13.53	6.65	4.90	24.40	0.17
Spring, 1933	54.03	15.91	6.46	4.40	18.82	0.38
Summer, 1933	51.66	13.80	7.29	4.00	22.93	0.31
Autumn, 1933	47.23	19.00	5.18	5.99	20.25	2.34
Average for second year	50.82	15.56	6.40	4.82	21.60	0.80
Child 4—Girl						
Winter, 1932	37.18	29.92	9.86	0.24	21.89	0.90
Spring, 1932	37.87	18.63	11.12	0.45	30.55	1.38
Summer, 1932	48.18	9.77	7.23	0.34	34.13	0.35
Autumn, 1932	47.15	15.76	6.68	1.08	28.81	0.52
Average for first year	42.60	18.52	8.72	0.53	28.84	0.79
Winter, 1933	41.56	13.64	6.23	2.34	35.28	0.94
Spring, 1933	39.07	9.45	7.00	2.26	41.53	0.70
Summer, 1933	44.19	9.07	7.22	1.38	37.88	0.25
Autumn, 1933	39.21	14.73	9.70	2.09	33.81	0.47
Average for second year	41.01	11.72	7.54	2.02	37.12	0.59
Child 5—Girl						
Winter, 1932	65.64	24.57	3.09	1.37	4.70	0.63
Spring, 1932	63.37	21.71	7.10	3.07	4.64	0.11
Summer, 1932	69.98	14.28	3.77	3.48	7.35	2.37
Autumn, 1932	59.47	16.62	8.04	4.18	11.35	0.34
Average for first year	64.62	19.30	5.50	3.02	7.01	0.86
Winter, 1933	53.17	16.07	8.70	5.05	16.42	0.60

TABLE 15.—Percentage of Protein Derived from Various Food Groups—Continued

Season	Milk	Cereal	Vegetable	Fruit	Meat and eggs	Fat (by difference)
Child 6—Girl						
Winter, 1932	48.04	11.43	10.75	4.23	24.93	0.62
Spring, 1932	56.68	16.25	5.42	3.13	18.12	0.40
Summer, 1932	56.85	10.71	7.90	2.75	21.53	0.97
Autumn, 1932	53.66	14.87	6.95	2.61	21.52	0.39
Average for first year	53.81	13.32	7.76	3.18	21.52	0.60
Winter, 1933	41.38	21.43	9.39	4.26	22.64	0.91
Spring, 1933	51.04	16.72	7.37	4.49	18.78	1.60
Summer, 1933	49.35	11.53	8.55	3.87	26.50	0.20
Autumn, 1933	45.96	17.20	8.12	4.33	23.15	1.23
Average for second year	46.93	16.72	8.36	4.24	22.77	0.98
Child 7—Boy						
Winter, 1932	53.30	16.44	6.58	2.69	20.03	0.96
Spring, 1932	55.85	13.64	6.41	3.03	20.79	0.28
Summer, 1932	54.27	14.63	7.74	2.00	20.97	0.40
Autumn, 1932	48.45	20.55	8.27	2.15	20.19	0.39
Average for first year	52.97	16.32	7.25	2.47	20.50	0.51
Winter, 1933	57.49	13.21	4.92	3.65	19.59	1.14
Spring, 1933	51.41	18.15	8.08	3.75	18.30	0.31
Summer, 1933	58.40	12.39	9.03	3.74	16.20	0.23
Autumn, 1933	46.65	19.77	10.91	4.06	17.92	0.69
Average for second year	53.49	15.88	8.24	3.80	18.00	0.59
Child 8—Boy						
Winter, 1932	62.25	11.79	6.14	3.73	15.65	0.44
Spring, 1932	57.28	12.41	5.73	2.38	21.61	0.59
Summer, 1932	59.13	10.30	6.31	1.90	21.01	1.35
Autumn, 1932	59.12	13.38	4.88	2.35	19.84	0.43
Average for first year	59.44	11.97	5.76	2.59	19.53	0.70
Winter, 1933	45.73	24.07	9.69	4.06	15.04	1.41
Spring, 1933	60.33	12.48	6.95	3.53	15.76	0.95
Summer, 1933	56.23	9.70	6.93	2.07	24.85	0.22
Autumn, 1933	56.22	11.56	6.00	3.78	21.95	0.49
Average for second year	54.63	14.45	7.39	3.36	19.40	0.77
Child 9—Girl						
Winter, 1932	40.27	26.05	7.08	3.47	22.43	0.70
Spring, 1932	49.72	15.35	6.68	4.68	22.90	0.67
Summer, 1932	48.69	23.48	6.62	4.35	16.44	0.43
Autumn, 1932	53.17	19.29	7.88	2.97	15.51	1.18
Average for first year	47.96	21.04	7.06	3.87	19.32	0.74
Winter, 1933	56.48	14.74	4.72	5.51	13.34	5.20
Spring, 1933	53.91	20.54	7.50	3.96	12.10	1.98
Summer, 1933	51.42	18.60	9.59	3.39	16.65	0.36
Autumn, 1933	58.04	12.86	8.85	3.10	16.63	0.52
Average for second year	54.96	16.68	7.66	3.99	14.68	2.02

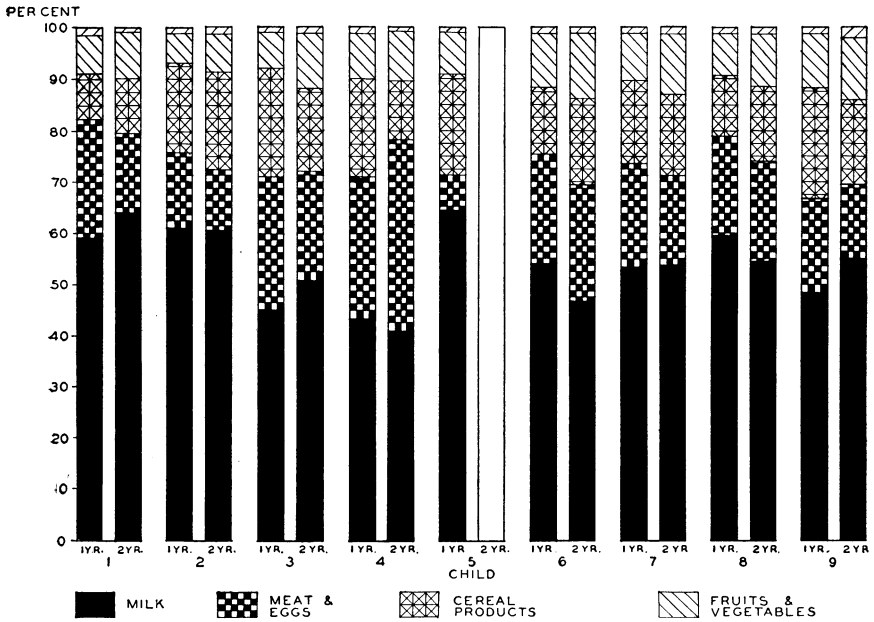

Fig. 11.—Percentage of protein derived from the food groups

The total percentage of protein derived from animal sources has been computed and is presented in Table 16 and Figure 12. These figures indicate that with this group of children there was little tendency to change the percentage of protein derived from animal foods from season to season and that the animal proteins constituted the larger part of the proteins used. This is accepted as good practice in that it assures the provision of protein of excellent quality.

TABLE 16.—Percentage of Protein Derived from Animal Sources

Season	Child 1	Child 2	Child 3	Child 4	Child 5	Child 6	Child 7	Child 8	Child 9
Winter, 1932	.....	74	64	59	70	73	73	78	63
Spring, 1932	.....	.....	72	68	68	75	77	79	73
Summer, 1932	84	84	75	82	77	78	75	80	65
Autumn, 1932	80	72	73	76	70	75	69	79	69
Average	82	77	71	71	71	75	74	79	68
Winter, 1933	84	69	75	77	70	70	64	77	61
Spring, 1933	79	71	73	81	.....	70	70	76	66
Summer, 1933	80	79	75	82	.....	76	75	81	68
Autumn, 1933	75	71	67	73	.....	69	65	78	75
Average	80	72	72	78	.....	71	68	78	68

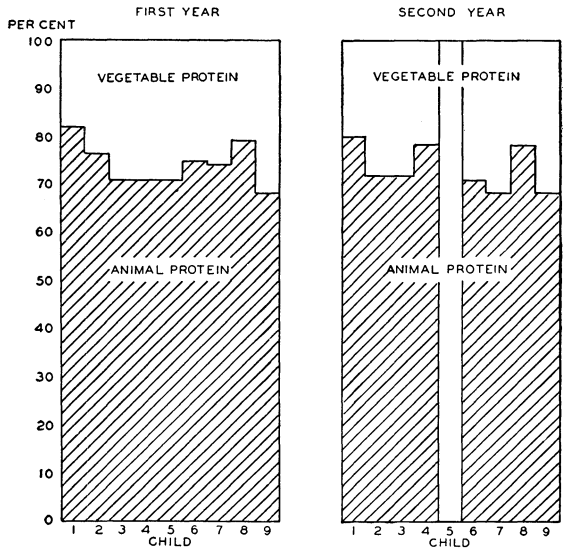

Fig. 12.—Percentage of protein derived from animal and from vegetable sources

MINERAL INTAKE OF PRESCHOOL CHILDREN

There are few records available at present as to the amounts of minerals in the diets of preschool children. Although the amounts included in the diets do not necessarily indicate the desirable intake, nevertheless, in the case of healthy normal children growing at the accepted rate, intakes are indicative of the amounts upon which maintenance and growth have been possible for such children and are, therefore, of value.

Average calcium, phosphorus, and iron intakes have been calculated for each child of the present study for each period of observation (Table 17). The data are summarized in Table 18 and in Figures 13 to 16.

In their study of foods used by girls from 6 to 13 years of age, Koehne and Morrell calculated the nutrients of the diets used by the group. Later, with similar diets and with a similar group of girls, balance studies were conducted. The results of the two studies were such that the authors were confident that the calculated figures for calcium and phosphorus were "reasonably accurate" (9).

The calculated figures herein presented concerning the mineral intake of preschool children may be considered as "reasonably accurate" and as representative of the approximate mineral intake of the children.

Daily calcium intakes per season ranged from 0.521 to 1.351, with an average of 0.946 gram for the entire group for the first year (Table 17). In the second year, the range during the seasons decreased somewhat (0.717 to 1.329) but the year's average increased to 1.015 grams daily. The average intake of the group for the second year was, therefore, slightly above the recommended standard of one gram daily.

TABLE 17.—Daily Calcium, Phosphorus, and Iron Intakes of Preschool Children

Season	Calcium			Phosphorus			Iron				Ca:P ratio
	Total grams	Per kg. Mgm.	Per cm. Mgm.	Total grams	Per kg. Mgm.	Per cm. Mgm.	Total milligrams	Per kg. Mgm.	Per cm. Mgm.	Per 100 cal. Mgm.	
Child 1—Boy											
Summer, 1932..	1.000	77.9	11.2	0.971	75.6	10.9	5.989	0.466	0.067	0.598	1.03 : 1
Autumn, 1932..	1.232	87.9	13.2	1.208	86.2	13.0	7.537	0.538	0.081	0.606	1.02 ; 1
Average...	1.116	82.9	12.2	1.090	80.9	12.0	6.763	0.502	0.074	0.602	1.02 : 1
Winter, 1933...	1.329	91.6	14.0	1.275	87.9	13.5	7.465	0.514	0.079	0.598	1.04 : 1
Spring, 1933....	1.260	82.1	13.0	1.191	77.6	12.3	7.507	0.489	0.077	0.569	1.06 : 1
Summer, 1933..	1.236	81.8	12.4	1.192	78.9	12.0	7.955	0.526	0.080	0.643	1.04 : 1
Autumn, 1933..	1.219	74.8	12.0	1.191	73.1	11.7	9.070	0.556	0.089	0.685	1.02 : 1
Average...	1.261	82.6	12.8	1.212	79.4	12.4	7.999	0.521	0.081	0.624	1.04 : 1
Child 2—Boy											
Winter, 1932...	0.980	73.7	11.5	0.968	72.8	11.4	5.886	0.443	0.069	0.493	1.01 : 1
Spring, 1932...	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Summer, 1932..	1.351	90.2	14.6	1.234	82.5	13.3	5.967	0.399	0.064	0.544	1.09 : 1
Autumn, 1932..	1.194	80.0	12.6	1.109	74.2	11.7	5.897	0.395	0.062	0.424	1.08 : 1
Average...	1.175	81.3	12.9	1.104	76.5	12.1	5.917	0.412	0.065	0.487	1.06 : 1
Winter, 1933...	1.184	75.4	12.2	1.152	73.4	11.9	7.350	0.468	0.076	0.520	1.03 : 1
Spring, 1933....	1.029	64.7	10.4	1.019	64.1	10.4	6.443	0.405	0.065	0.538	1.01 : 1
Summer, 1933..	1.151	69.6	11.5	1.090	65.9	10.9	7.650	0.463	0.076	0.604	1.06 : 1
Autumn, 1933..	1.241	73.5	12.1	1.178	69.8	11.5	7.923	0.470	0.077	0.551	1.05 : 1
Average...	1.151	70.8	11.6	1.110	68.3	11.2	7.342	0.452	0.074	0.553	1.04 : 1
Child 3—Boy											
Winter, 1932...	0.804	58.4	9.7	0.970	70.4	11.7	7.655	0.556	0.092	0.649	0.83 : 1
Spring, 1932....	0.910	63.7	10.6	0.969	67.8	11.3	6.666	0.466	0.078	0.595	0.94 : 1
Summer, 1932..	0.680	47.7	7.8	0.847	59.4	9.7	7.215	0.506	0.082	0.690	0.80 : 1
Autumn, 1932..	0.838	57.3	9.3	0.893	61.1	9.9	7.664	0.524	0.085	0.636	0.94 : 1
Average...	0.808	56.8	9.4	0.920	64.7	10.6	7.300	0.513	0.084	0.642	0.88 : 1
Winter, 1933...	0.873	56.6	9.4	0.944	61.2	10.2	7.836	0.508	0.085	0.655	0.92 : 1
Spring, 1933....	1.048	65.0	10.9	1.084	67.2	11.3	8.489	0.526	0.089	0.659	0.97 : 1
Summer, 1933..	0.985	60.2	10.1	1.042	63.6	10.7	8.778	0.536	0.090	0.721	0.95 : 1
Autumn, 1933..	0.799	45.7	8.0	0.857	49.0	8.6	7.699	0.440	0.077	0.628	0.93 : 1
Average...	0.926	56.9	9.6	0.982	60.2	10.2	8.200	0.502	0.085	0.666	0.94 : 1
Child 4—Girl											
Winter, 1932...	0.521	40.7	6.3	0.653	51.1	7.9	5.123	0.401	0.062	0.501	0.80 : 1
Spring, 1932....	0.654	50.0	7.7	0.802	61.4	9.4	7.236	0.554	0.085	0.652	0.82 : 1
Summer, 1932..	0.784	59.1	9.0	0.825	62.2	9.4	6.175	0.465	0.071	0.635	0.95 : 1
Autumn, 1932..	0.865	62.2	9.6	0.922	66.4	10.2	7.074	0.509	0.078	0.602	0.94 : 1
Average...	0.706	53.0	8.2	0.800	60.3	9.2	6.402	0.482	0.074	0.598	0.88 : 1
Winter, 1933...	0.717	48.8	7.8	0.856	58.3	9.3	6.701	0.456	0.073	0.667	0.84 : 1
Spring, 1933....	0.830	52.8	8.8	0.994	63.2	10.5	9.374	0.596	0.099	0.772	0.84 : 1
Summer, 1933..	0.802	49.6	8.2	0.870	53.8	8.9	7.530	0.466	0.077	0.753	0.92 : 1
Autumn, 1933..	0.741	47.6	7.6	0.852	54.7	8.7	8.471	0.544	0.087	0.700	0.87 : 1
Average...	0.772	49.7	8.1	0.893	57.5	9.4	8.019	0.516	0.084	0.723	0.86 : 1
Child 5—Girl											
Winter, 1932...	0.791	65.8	9.0	0.765	63.6	8.7	4.887	0.407	0.056	0.460	1.03 : 1
Spring, 1932....	0.861	68.9	9.8	0.845	67.6	9.6	5.389	0.431	0.061	0.498	1.02 : 1
Summer, 1932..	0.834	65.4	9.2	0.770	60.4	8.5	3.949	0.310	0.044	0.414	1.08 : 1
Autumn, 1932..	0.892	66.7	9.5	0.884	66.1	9.4	5.962	0.446	0.064	0.510	1.01 : 1
Average...	0.844	66.7	9.4	0.816	64.4	9.0	5.047	0.398	0.056	0.470	1.03 : 1
Winter, 1933...	0.759	53.9	8.0	0.788	55.9	8.3	6.254	0.444	0.066	0.615	0.96 : 1

TABLE 17.—Daily Calcium, Phosphorus, and Iron Intakes of Preschool Children—Continued

Season	Calcium			Phosphorus			Iron				Ca : P ratio
	Total grams	Per kg. Mgm.	Per cm. Mgm.	Total grams	Per kg. Mgm.	Per cm. Mgm.	Total milligrams	Per kg. Mgm.	Per. cm. Mgm.	Per 100 cal. Mgm.	
Child 6—Girl											
Winter, 1932...	0.832	52.2	9.1	0.855	53.7	9.3	8.520	0.535	0.093	0.688	0.97 : 1
Spring, 1932...	1.161	70.3	12.6	1.171	71.0	12.7	8.602	0.521	0.093	0.601	0.99 : 1
Summer, 1932..	1.208	70.8	12.8	1.215	71.2	12.8	8.702	0.510	0.092	0.671	0.99 : 1
Autumn, 1932..	0.992	55.0	10.1	1.008	55.9	10.3	7.916	0.439	0.081	0.643	0.98 : 1
Average...	1.048	62.1	11.2	1.062	63.0	11.3	8.435	0.501	0.090	0.651	0.99 : 1
Winter, 1933...	1.058	56.1	10.6	1.087	57.6	10.9	9.220	0.489	0.092	0.671	0.97 : 1
Spring, 1933....	1.138	57.3	11.0	1.214	61.1	11.8	9.682	0.487	0.094	0.645	0.94 : 1
Summer, 1933..	1.004	50.0	9.5	1.088	54.2	10.3	10.024	0.499	0.095	0.812	0.92 : 1
Autumn, 1933..	0.976	47.0	9.0	1.067	51.4	9.9	9.483	0.456	0.088	0.718	0.91 : 1
Average...	1.044	52.6	10.0	1.114	56.1	10.7	9.602	0.483	0.092	0.712	0.94 : 1
Child 7—Boy											
Winter, 1932...	0.908	54.8	9.3	0.937	56.6	9.6	7.014	0.424	0.072	0.517	0.97 : 1
Spring, 1932....	0.963	57.3	9.8	0.987	58.7	10.1	7.482	0.445	0.076	0.588	0.98 : 1
Summer, 1932..	1.191	68.6	11.8	1.231	70.9	12.2	9.656	0.557	0.096	0.632	0.97 : 1
Autumn, 1932..	0.990	56.0	9.6	1.084	61.2	10.5	8.873	0.502	0.086	0.641	0.91 : 1
Average...	1.013	59.2	10.1	1.060	61.8	10.6	8.256	0.482	0.082	0.594	0.96 : 1
Winter, 1933...	0.858	46.4	8.2	1.007	54.5	9.6	9.258	0.501	0.089	0.672	0.85 : 1
Spring, 1933....	0.950	48.7	8.9	0.996	51.1	9.4	7.574	0.388	0.071	0.600	0.95 : 1
Summer, 1933..	1.240	62.0	11.4	1.273	63.6	11.7	9.764	0.488	0.090	0.658	0.97 : 1
Autumn, 1933..	1.033	51.1	9.3	1.168	57.8	10.5	10.977	0.543	0.099	0.687	0.88 : 1
Average...	1.020	52.0	9.4	1.111	56.8	10.3	9.393	0.480	0.087	0.654	0.92 : 1
Child 8—Boy											
Winter, 1932...	1.020	68.4	10.5	1.001	67.1	10.3	7.202	0.483	0.074	0.534	1.02 : 1
Spring, 1932....	1.102	73.4	11.2	1.110	73.9	11.3	7.202	0.479	0.073	0.517	0.99 : 1
Summer, 1932..	0.953	60.6	9.4	0.934	59.3	9.2	5.261	0.334	0.052	0.449	1.02 : 1
Autumn, 1932..	1.192	71.0	11.6	1.178	70.2	11.4	8.117	0.484	0.079	0.581	1.01 : 1
Average...	1.067	68.4	10.7	1.056	67.6	10.6	6.945	0.445	0.070	0.520	1.01 : 1
Winter, 1933...	1.097	63.9	10.5	1.083	63.0	10.4	7.211	0.420	0.069	0.553	1.01 : 1
Spring, 1933....	1.037	58.1	9.7	1.029	57.7	9.7	6.607	0.371	0.062	0.521	1.01 : 1
Summer, 1933..	1.009	55.0	9.4	1.005	54.7	9.3	8.082	0.440	0.075	0.717	1.00 : 1
Autumn, 1933..	1.234	61.0	11.1	1.219	60.3	10.9	9.924	0.491	0.089	0.622	1.01 : 1
Average...	1.094	59.5	10.2	1.084	58.7	10.1	7.956	0.430	0.074	0.603	1.01 : 1
Child 9—Girl											
Winter, 1932...	0.791	58.7	8.4	0.879	65.3	9.3	8.156	0.606	0.087	0.624	0.90 : 1
Spring, 1932...	0.892	66.1	9.4	0.946	70.2	10.0	8.466	0.628	0.089	0.718	0.94 : 1
Summer, 1932..	0.799	57.2	8.2	0.839	60.0	8.6	6.982	0.499	0.072	0.605	0.95 : 1
Autumn, 1932..	1.025	70.4	10.3	1.058	72.6	10.6	8.240	0.566	0.083	0.618	0.97 : 1
Average...	0.877	63.1	9.1	0.930	67.0	9.6	7.961	0.575	0.083	0.641	0.94 : 1
Winter, 1933...	0.904	59.4	9.0	1.017	68.8	10.1	8.489	0.558	0.084	0.632	0.89 : 1
Spring, 1933....	1.119	72.8	10.8	1.169	76.0	11.3	7.622	0.496	0.074	0.537	0.96 : 1
Summer, 1933..	1.140	69.7	10.9	1.201	73.4	11.4	10.492	0.641	0.100	0.735	0.95 : 1
Autumn, 1933..	1.265	74.2	11.8	1.259	73.9	11.7	9.311	0.546	0.087	0.685	1.00 : 1
Average...	1.107	69.0	10.6	1.162	73.0	11.1	8.978	0.560	0.086	0.647	0.95 : 1
Total average for 1st. year	0.946	65.4	.....	0.972	67.4	.....	7.032	0.485	.....	0.589	0.97 : 1
Total average for 2nd. year	1.015	61.6	.....	1.051	63.8	.....	7.499	0.493	.....	0.648	0.96 : 1

TABLE 18.—Average Mineral Intakes of Preschool Children for Each of 2 Years

Child	Calcium			Phosphorus			Iron				Ca : P ratio
	Total grams	Per kg. Mgm.	Per cm. Mgm.	Total grams	Per kg. Mgm.	Per cm. Mgm.	Total milligrams	Per kg. Mgm.	Per cm. Mgm.	Per 100 cal. Mgm.	
First year											
1.	1.116	82.9	12.2	1.090	80.9	12.0	6.763	0.502	0.074	0.602	1.02 : 1
2.	1.175	81.3	12.9	1.104	76.5	12.1	5.917	0.412	0.065	0.487	1.06 : 1
3.	0.808	56.8	9.4	0.920	64.7	10.6	7.300	0.513	0.084	0.642	0.88 : 1
4.	0.706	53.0	8.2	0.800	60.3	9.2	6.402	0.482	0.074	0.598	0.88 : 1
5.	0.844	66.7	9.4	0.816	64.4	9.0	5.047	0.398	0.056	0.470	1.03 : 1
6.	1.048	62.1	11.2	1.062	63.0	11.3	8.435	0.501	0.090	0.651	0.99 : 1
7.	1.013	59.2	10.1	1.060	61.8	10.6	8.256	0.482	0.082	0.594	0.96 : 1
8.	1.067	68.4	10.7	1.056	67.6	10.6	6.945	0.445	0.070	0.520	1.01 : 1
9.	0.877	63.1	9.1	0.930	67.0	9.6	7.961	0.575	0.083	0.641	0.94 : 1
Second year											
1.	1.261	82.6	12.8	1.212	79.4	12.4	7.999	0.521	0.081	0.624	1.04 : 1
2.	1.151	70.8	11.6	1.110	68.3	11.2	7.342	0.452	0.074	0.553	1.04 : 1
3.	0.926	56.9	9.6	0.982	60.2	10.2	8.200	0.502	0.085	0.666	0.94 : 1
4.	0.772	49.7	8.1	0.893	57.5	9.4	8.019	0.516	0.084	0.723	0.86 : 1
5.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
6.	1.044	52.6	10.0	1.114	56.1	10.7	9.602	0.483	0.092	0.712	0.94 : 1
7.	1.020	52.0	9.4	1.111	56.8	10.3	9.393	0.480	0.087	0.654	0.92 : 1
8.	1.094	59.5	10.2	1.084	58.7	10.1	7.956	0.430	0.074	0.603	1.01 : 1
9.	1.107	69.0	10.6	1.162	73.0	11.1	8.978	0.560	0.086	0.647	0.95 : 1

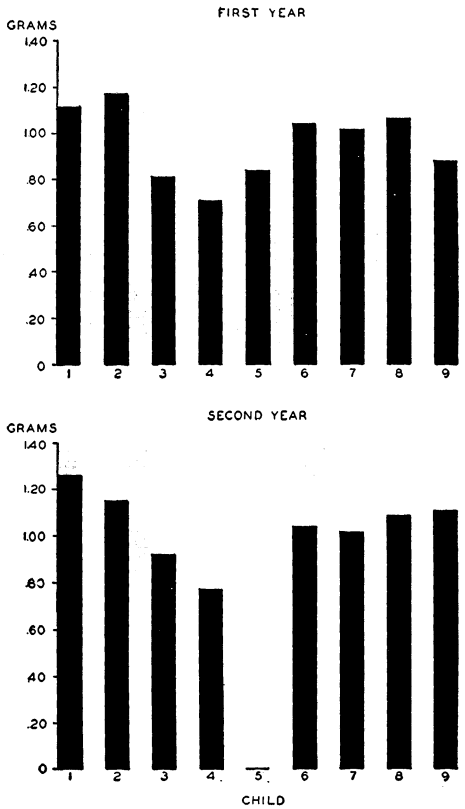

Fig. 13.—Average calcium intake of individual preschool children for each of two years

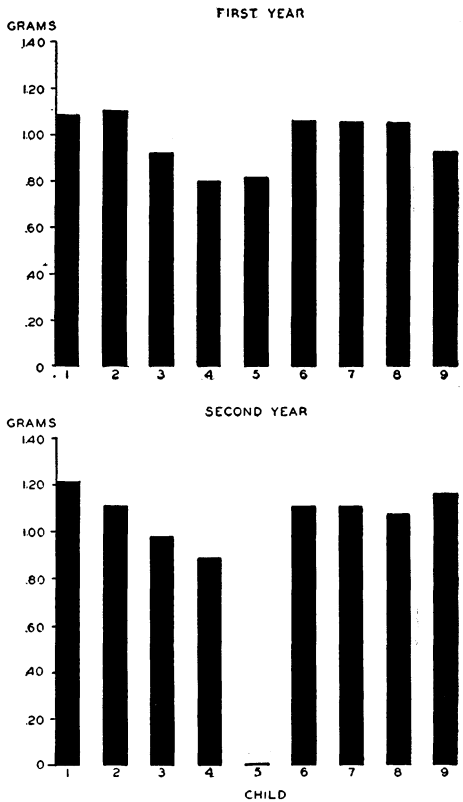

Fig. 14.—Average phosphorus intake of individual preschool children for each of two years

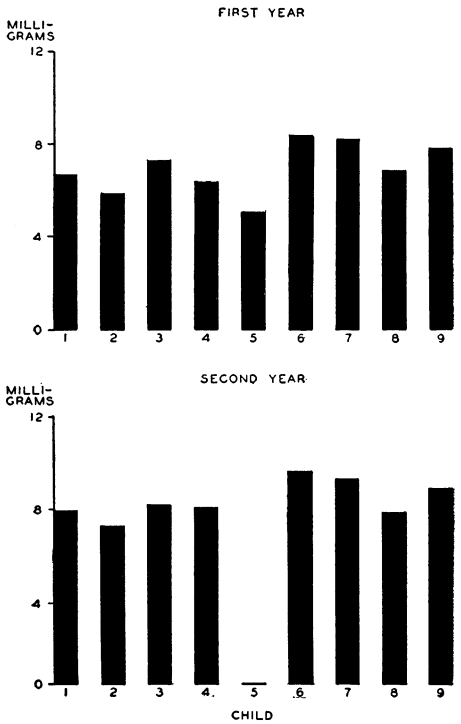

Fig. 15.—Average iron intake of preschool children for each of two years

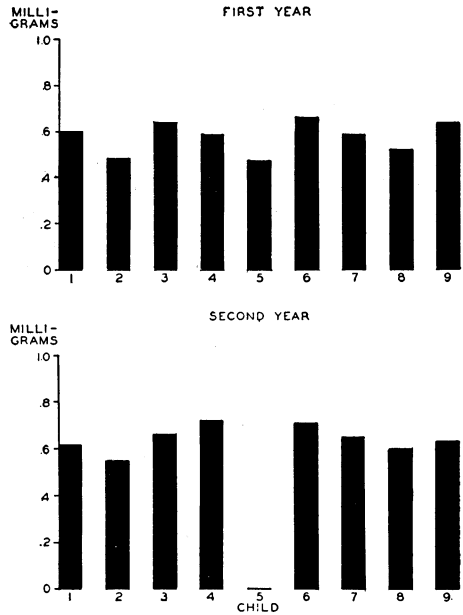

Fig. 16.—Average iron intakes per 100 calories of preschool children for each of two years

Five children in all, three of the older children and two of the younger ones, averaged a gram or more of calcium daily for each of the 2 years. Another one of the older children who averaged less than a gram daily during the first year increased the amount to more than a gram the second year. In the main, calcium intakes increased during the second year.

During two seasons of the entire period of the study, one child averaged less calcium than the amount of the adult standard of 0.68 gram daily. In all other cases, the intakes were greater than the amount of the adult standard.

The amount of calcium is, of course, dependent to a large extent upon the amount of milk in the diets. Those children who averaged approximately three cups of milk in the diet daily averaged a gram or more calcium. With smaller amounts of milk, the calcium intakes were proportionately decreased. Calcium intakes did not vary with the age of the child but with the habit in regard to milk. Two of the younger children who used larger amounts of milk than the other children in the group, therefore, had the highest calcium intakes of the group. The three other younger children were taking less milk than the others and consequently had lower calcium intakes.

Children of the same age varied in their calcium intake per kilogram much as they varied in their total calcium intake. Older children with milk drinking habits similar to younger children naturally averaged less calcium per kilogram than did the younger children. Average amounts of calcium per kilogram decreased slightly the second year over corresponding amounts for the first year. That the decreases were not greater was, undoubtedly, due to the fact that the milk consumption increased the second year to a greater extent proportionately than did the weight of the children.

Table 19, showing the values of t for the calcium intake in relation to age, weight, height, and calorie and protein intakes, brings out the point that there was no significant relationship between calcium intake and age. The habit in regard to milk drinking was the factor influential in determining calcium intake, and this habit was not a habit directly influenced by age among the children studied. Approximately the same lack of relationship holds for calcium intake in relation to weight. The relation of calcium intake to height was somewhat more significant, t of 2.682 indicating that there was somewhat less than one chance in a hundred that such differences as were found between the average for the heights selected would occur by chance. This relationship would seem to indicate that the calcium intake had influenced the height.

TABLE 19.—Values of t When Calcium, Phosphorus, and Iron are Referred to Age, Weight, Height, and Calorie and Protein Intakes*

Total intake	Age	Weight	Height	Calorie intake	Protein intake
	18-41 mos. 42-65 mos.	12-16 kgs. 17-21 kgs.	82- 96 cms. 97-111 cms.	950-1274 1275-1600	28-41 gms. 42-55 gms.
Calcium	1.580	1.732	2.682	4.589	7.292
Phosphorus	2.352	2.851	3.428	6.069	8.337
Iron	3.635	4.654	4.396	4.764	4.613

*t of 2.576—less than one chance in 100 that the differences would be exceeded by chance.

In connection with the retention of calcium from early infancy to adolescence, Stearns has recently reported that "the curves of intake and retention per kilo versus age exhibited no parallelism. In contrast to the differing slopes of the per kilo intake and retention curves, all the curves of daily retention per kilo during growth parallel very closely the curve of yearly increments of growth in height" (21).

As might be expected, calcium intake showed a significant relationship to calorie intake but a decidedly closer relationship to protein intake. As shown in a preceding section, milk provided a generous proportion of the protein eaten by this group of children and, therefore, a close relationship between protein intake and calcium of the diets was assured.

The total daily phosphorus intakes per season ranged from 0.653 to 1.234 grams, with a group average of 0.972 gram for the first year. For the second year, the range per season was from 0.852 to 1.275, with a group average for the year of 1.051, the phosphorus increases thus paralleling the calcium increases (Table 17).

The same five children whose calcium intake averaged a gram or more daily also averaged a gram or more of phosphorus daily. Without exception, phosphorus intakes increased during the second year, with phosphorus per kilogram decreasing to about the same extent as did calcium per kilogram.

As shown in Table 19, the relation between phosphorus intake and age was not significant, but the relationships between phosphorus intake and weight, as well as height, were both significant, especially the latter. As might be expected, phosphorus intake was significantly related to calorie intake but more so in regard to total protein intake. The food intake of the adolescent girls of the Wait and Roberts study also showed a closer relationship between protein and phosphorus than between calories and phosphorus, although the correlations for both were high.

For their adolescent girls, Wait and Roberts have reported an average calcium intake of 1.118 grams daily. This average is only slightly higher than the average intake of 0.98 gram for these preschool children. On the other hand, the average phosphorus intake of the adolescent girls was 1.425 grams, as compared to an average intake of 1.012 grams daily for the preschool children. The calcium-phosphorus ratio for the adolescent girls was 0.79:1, as compared to a corresponding ratio of 0.97:1 for the first year and of 0.96:1 for the second year for the preschool children. The explanation of the differences in the ratios for the two groups lies in the fact that the amounts of milk used by children did not vary with age as did the amounts of other foods which provided phosphorus in the diet.

Iron.—During the first year, daily average iron intakes per season ranged from 3.949 to 9.656, with a yearly average for the group of 7.032 milligrams. For the second year, the corresponding figures were from 6.254 to 10.977, with an average of 7.499, thus showing a decidedly decreased range and an increased average.

A total iron intake, as shown by the value of t (Table 19), was significantly related to age, weight, and height as well as to calorie and protein intake.

Milligrams of iron per kilogram of body weight per season ranged from 0.310 to 0.628, with an average of 0.485 for the first year. For the second year, the corresponding range was from 0.371 to 0.641, with an average of 0.493, a slight increase over the average of the first year, showing that the iron

intakes increased proportionally more than did weight. These preschool children averaged more iron per kilogram than did the group of girls from 7 to 11 years of age whose food intakes have been reported by Koehne and Morrell (9) and decidedly more than the adolescent girls of the Wait and Roberts study (26).

A convenient method of evaluating the iron in the diets of young children is on the basis of iron intake per 100 calories. During the first year, the iron intake of the individual children ranged from 0.414 to 0.718, with an average of 0.589 milligrams per 100 calories. During this year, no child reached the standard of 0.75 milligrams per 100 calories suggested by Rose (18). Three of the nine children average 0.62 or more milligrams of iron per 100 calories, the amount of the tentative standard suggested by Leischenrung and Flor (10).

During the second year, iron intakes ranged from 0.520 to 0.812, with an average of 0.648 milligram per 100 calories. For two seasons of this year, one child averaged as much or more iron than the amount of the suggested standard of Rose, while the iron intake of only one child fell much below the somewhat more moderate tentative standard of Leischenrung and Flor. Unless food habits of children are to be changed, the standard of 0.62 milligram of iron per 100 calories seems to be as high a standard as can be attained. Although this group of children was using generous amounts of fruits, vegetables, eggs, whole cereals, and moderate amounts of liver and muscle cuts of meat, the foods which, in the main, are depended upon for provision of iron in the diets, a decrease in the amount of sugar used would, undoubtedly, increase the iron intake per 100 calories.

The iron intake of this group of children has been discussed in greater detail elsewhere (11).

Hemoglobin, in general, was reported by the attending pediatrician as being well up to standards. Special observations made after the study was completed showed hemoglobin values to be in the upper range of values usually found for children. For about half the children the seasons of highest hemoglobin values were coincident with seasons of greatest iron intake on the basis of milligrams of iron per 100 calories.

VITAMIN INTAKE OF PRESCHOOL CHILDREN

Although, at the present time, quantitative determinations of the vitamin value of diets can be little better than approximations, such figures as are available concerning the vitamin value of individual foods have been used to estimate the vitamin A, B, C, and G values of the individual diets for each season (16). A summary of the data thus obtained is presented in Table 20.

Standards of vitamin intake are still purely tentative, but it is interesting to note that the judgment expressed concerning the vitamin values of the diets before the calculations were made remained unchanged after the figures were available.

Foods which are valuable in the diets as sources of vitamin A were used in generous amounts by the children of the group. Whole milk, butter, liver, eggs, green leafy vegetables, and vegetables of yellow color all appeared in the diets in such amounts as to assure a generous provision of vitamin A.

Average daily intakes of vitamin A ranged from 283 to 485 units, with a group average of 388 per 100 calories for the first year of the study. During the second year, the corresponding range was from 304 to 505, with a yearly

average for the group of 423 units per 100 calories. Rose has suggested for children a tentative standard of 200 units per 100 calories per day (16). Evidently this group of children was getting ample amounts of vitamin A, not only for their present needs but for storage. Upon the basis of long continued, carefully controlled experimental work with animals, Sherman says, "We now have good reason to believe that a surplus of vitamin A in the body is not simply a reserve asset to be used at some future time, but also actively increases the vigor and the ability of the body to resist disease" (20).

TABLE 20.—Estimated Average Vitamin Intakes of Individual Preschool Children

Child	Average calories	Vitamin A units		Vitamin B units		Vitamin C units		Vitamin G units	
		Total	Per 100 cal.	Total	Per 100 cal.	Total	Per 100 cal.	Total	Per 100 cal.
First year									
1	1122	4621	412	357	32	93	8	679	61
2	1223	3467	283	280	23	77	6	494	40
3	1138	4123	362	311	27	132	12	483	42
4	1070	4121	385	261	24	81	8	475	44
5	1066	3112	292	303	28	92	9	474	44
6	1300	6308	485	374	29	80	6	646	50
7	1386	5611	405	368	27	129	9	633	46
8	1328	5570	419	357	27	104	8	637	48
9	1244	5602	450	277	22	107	9	506	41
Average			388		27		8		46
Second year									
1	1283	5381	419	412	32	104	8	765	60
2	1329	4045	304	282	21	66	5	512	39
3	1232	5141	417	333	27	125	10	588	48
4	1108	5124	462	284	26	109	10	546	49
5									
6	1358	6729	496	397	29	99	7	669	49
7	1430	5391	377	358	25	101	7	610	43
8	1324	6689	505	389	29	108	8	770	58
9	1388	5570	401	349	25	117	8	608	44
Average			423		27		8		49

The situation in regard to provision of vitamin B in the diets of the group of preschool children whose diets were studied was not as favorable as that in regard to vitamin A. For the first year, the average intake of vitamin B ranged from 22 to 32 units, with a group average of 27 units per 100 calories. During the second year of the study, the figures remained practically unchanged.

Although only one child exceeded the suggested tentative standard of 30 units of vitamin B per 100 calories, five other children had amounts only slightly less than the standard. The three remaining children were less liberally provided with vitamin B, and some question as to the adequacy of their diets in this factor may be raised.

The fact that sugar and fats occupied such a prominent place in the dietaries of this group of children may account for the limited amounts of vitamin B in the diet. Children having the lower amounts of vitamin B averaged a higher percentage of calories from sugar and fats, foods which increase the calorie value of the diets without increasing the vitamin B values.

In a preliminary report of the foods used by this group of preschool children, the question of the adequacy of the diets in regard to provision of vitamin B was raised. More detailed study of the diets shows that the provision for vitamin B was, undoubtedly, less liberal than the provision for the other vitamins. It is probably true that the diets used by many preschool children may contain too little vitamin B and that the routine use of some rich source of vitamin B may be desirable. An alternative would be to reduce the amounts of highly refined foods in the diets of children and to bring into such diets additional amounts of natural foods such as the whole cereal products and fruits and vegetables, in addition to the generous amounts of milk which the well selected diet contains.

Foods which have been demonstrated to be excellent sources of vitamin C were used generously, orange juice as well as tomato juice appearing in the diets approximately every day. This regularity of intake of vitamin C is important because the body has little capacity for storing this vitamin and its importance in nutrition seems to be greater than was originally thought.

Average daily amounts of vitamin C in the diets ranged from 80 to 132 units, with a group average of 99 for the first year. For the second year, the range was from 66 to 125, with a group average of 104 units. These amounts are all much higher than the suggested standard of 20 units daily. "There is no evidence that a large amount of vitamin C does any harm and much to show that liberal amounts are good health insurance" (16).

Average daily amounts of vitamin G in the diets ranged from 474 to 679 units, with a group average of 559 for the first year. Corresponding figures for the second year were 512 to 765, with a yearly group average of 633. On the basis of units per 100 calories, the individual children varied in the average daily amount used during the first year from 40 to 61, with a group average of 46 units. For the second year, corresponding averages were 39 to 60 with a group average of 49. No standards are available for comparison, but from the amounts of liver, lean meat, eggs, milk, and vegetables used it may be assumed that the vitamin G provision was adequate.

The routine use of cod-liver oil assured provision of vitamin D during most of the seasons for most of the children.

SPECIFIC FOODS USED BY PRESCHOOL CHILDREN

Although the distribution of total calories among the food groups gives a good indication of the types of food used by an individual, there is considerable interest in the specific foods within each group of foods, in the amounts in which such foods are used, and in the changes in respect to the use of specific foods which may occur from season to season in the diets of preschool children. At the International Conference of Nutritionists in Rome in 1932, the recommendation was made that complete details of actual foods used be included in the reports of each dietary study, so that those interested in special aspects of the diet might analyze data from other standpoints than those presented by an author (3). Data concerning specific foods used by individual children are, therefore, presented in Table 21.

TABLE 21.—Specific Foods Used by Individual Preschool Children During Each Season of a 2-year Period

Child I

Food	1932				1933			
	Winter	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn
	Grams	*Grams*	*Grams*	*Grams*	*Grams*	*Grams*	*Grams*	*Grams*
Milk	.....	.....	5218	6397	7046	6311	6440	6340
Bread, White	.....	.....	74	110	19	55	67	56
Bread, Whole Wheat	.....	.....	.....	40	63	161	89	160
Crackers, Soda	.....	.....	10	13	9	16	.....	.....
Crackers, Graham	.....	.....	.....	14	.....	.....	.....	.....
Bran Flakes	.....	.....	.....	33	.....	27	46	.....
Cornflakes	.....	.....	28	.....	.....	.....	.....	18
Rice Flakes	.....	.....	.....	6	.....	.....	.....	.....
Shredded Wheat	.....	.....	.....	.....	.....	.....	.....	28
Whole Wheat Flakes	.....	.....	.....	.....	30	.....	.....	.....
Cream of Wheat	.....	.....	12	.....	43	39	40	37
Farina or Ralston	.....	.....	.....	46	14	.....	35	22
Oats, Rolled	.....	.....	36	50	58	46	.....	39
Rice	.....	.....	.....	35	.....	40	9	32
Macaroni	.....	.....	.....	34	.....	.....	8	8
Tapioca	.....	.....	.....	.....	30	.....	2	3
Potatoes, Irish	.....	.....	571	247	569	363	254	576
Asparagus	.....	.....	68	.....	.....	.....	5	.....
Beans, Green	.....	.....	.....	.....	.....	.....	.....	62
Beets	.....	.....	.....	.....	.....	85	87	.....
Carrots	.....	.....	.....	118	94	17	52	27
Cauliflower	.....	.....	.....	.....	.....	83	.....	23
Celery	.....	.....	.....	63	16	72	.....	.....
Onions	.....	.....	.....	.....	.....	18	63	14
Peas	.....	.....	.....	.....	.....	.....	.....	69
Tomatoes (Fresh)	.....	.....	20	242	.....	.....	.....	.....
Turnips	.....	.....	.....	.....	23	10	.....	.....
Radishes	.....	.....	.....	.....	.....	.....	12	.....
Squash	.....	.....	126	.....	.....	.....	.....	.....
Cabbage	.....	.....	.....	.....	41	28	3	3
Lettuce	.....	.....	1	10	.....	10	12	10
Spinach	.....	.....	95	.....	.....	118	71	75
Beans, Green (Canned)	.....	.....	.....	.....	75	91	67	.....
Beans, Lima (Canned)	.....	.....	.....	.....	31	.....	.....	.....
Peas (Canned)	.....	.....	144	36	105	94	50	.....
Tomatoes (Canned)	.....	.....	52	491	202	320	434	521
Oranges	.....	.....	606	731	466	967	719	543
Grapefruit	.....	.....	.....	.....	93	.....	.....	100
Pineapple (Fresh)	.....	.....	.....	.....	.....	.....	74	.....
Apples	.....	.....	390	129	189	324	154	209
Bananas	.....	.....	100	83	121	150	339	139
Grapes	.....	.....	.....	65	27	.....	.....	.....
Pears	.....	.....	.....	56	.....	.....	.....	71
Strawberries	.....	.....	.....	.....	.....	.....	94	.....
Apricots (Dried)	.....	.....	.....	64	.....	.....	57	190
Prunes	.....	.....	.....	.....	60	32	.....	75
Apricots (Canned)	.....	.....	.....	.....	.....	149	.....	.....
Peaches (Canned)	.....	.....	.....	110	142	.....	429	89
Pears (Canned)	.....	.....	.....	.....	.....	233	162	.....
Pineapple (Canned)	.....	.....	.....	.....	71	.....	.....	.....
Eggs	.....	.....	363	355	239	225	189	128
Beef	.....	.....	62	106	.....	17	31	31
Lamb	.....	.....	52	43	46	.....	58	35
Liver	.....	.....	.....	.....	23	70	33	33
Haddock	.....	.....	.....	.....	78	.....	.....	19
Salmon	.....	.....	.....	.....	30	.....	.....	.....
Chicken	.....	.....	10	.....	.....	.....	.....	.....
Bacon	.....	.....	.....	.....	.....	1	.....	.....
Butter	.....	.....	42	50	45	90	65	59
Corn Syrup	.....	.....	1	27	.....	14	25	26
Sugar	.....	.....	116	113	117	116	85	155

TABLE 21.—Specific Foods Used by Individual Preschool Children During Each Season of a 2-year Period—Continued

Child II

Food	1932				1933			
	Winter	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn
	Grams	*Grams*	*Grams*	*Grams*	*Grams*	*Grams*	*Grams*	*Grams*
Milk, Whole	4973	.....	3576	4524	5360	3198	4298	4997
Milk, Skim	.....	.....	3433	915	852	2186	1667	1420
Bread, Whole Wheat	.....	.....	88	.....	164	172	105	148
Bread, White	185	.....	133	230	211	137	166	228
Crackers, Soda	.....	.....	.....	32	30	29	8	12
Crackers, Graham	44	.....	.....	16	.....	.....	.....	.....
Cornflakes	.....	.....	29	.....	.....	.....	55	.....
Rice Flakes	.....	.....	56	10	.....	.....	25	35
Wheaties	.....	.....	.....	.....	30	43	.....	.....
Cornmeal	.....	.....	.....	.....	.....	17	.....	41
Cream of Wheat	77	.....	48	64	58	69	.....	42
Farina or Ralston	108	.....	.....	.....	98	.....	.....	.....
Macaroni	28	.....	4	7	10	1	5	6
Oats, Rolled	.....	.....	47	66	.....	26	.....	.....
Rice	96	.....	2	40	15	8	5	27
Tapioca	.....	.....	.....	.....	.....	.....	3	4
Cake and Cookies	.....	.....	.....	8	121	112	56	.....
Potatoes, Irish	267	.....	294	313	339	278	262	624
Asparagus	.....	.....	14	.....	.....	.....	18	.....
Beans, Green	.....	.....	.....	31	.....	.....	.....	77
Beets	.....	.....	.....	.....	37	26	46	59
Carrots	.....	.....	36	49	4	45	31	27
Cauliflower	42	.....	6	.....	6	16	16	32
Celery	.....	.....	.....	.....	.....	10	.....	5
Onions	10	.....	4	.....	16	14	.....	27
Peas (Fresh)	.....	.....	39	26	.....	.....	50	70
Turnips	.....	.....	.....	.....	10	.....	.....	.....
Cabbage	.....	.....	9	.....	5	3	.....	.....
Lettuce	.....	.....	5	.....	.....	.....	.....	5
Spinach	129	.....	21	46	25	33	83	54
Beans, Green (Canned)	62	.....	43	.....	38	81	74	.....
Beans, Kidney (Can'd)	60	.....	.....	.....	.....	.....	.....	.....
Corn (Canned)	.....	.....	.....	.....	45	17	31	.....
Peas (Canned)	58	.....	.....	.....	40	53	.....	.....
Tomatoes (Canned)	370	.....	61	122	435	247	439	413
Oranges	980	.....	1007	60	97	333	198	267
Apples	33	.....	29	.....	71	83	116	152
Bananas	62	.....	.....	.....	106	130	228	125
Peaches	.....	.....	.....	131	.....	.....	.....	.....
Pears	.....	.....	.....	.....	.....	.....	.....	71
Strawberries	.....	.....	.....	.....	.....	.....	59	.....
Apricots	.....	.....	28	.....	19	14	14	22
Prunes	.....	.....	31	336	175	227	25	197
Cherries (Canned)	.....	.....	.....	.....	.....	50	.....	.....
Grapefruit (Canned)	.....	.....	65	.....	.....	.....	.....	.....
Peaches (Canned)	290	.....	119	.....	130	223	255	89
Pears (Canned)	.....	.....	.....	64	80	110	80	74
Eggs	114	.....	209	164	64	117	206	78
Beef	110	.....	39	58	37	37	35	49
Lamb	.....	.....	49	.....	20	33	39	8
Liver	.....	.....	5	.....	16	26	33	52
Haddock	.....	.....	21	.....	.....	.....	.....	25
Chicken	50	.....	.....	.....	.....	.....	.....	.....
Bacon	13	.....	6	.....	.....	6	17	.....
Butter	57	.....	80	100	122	88	76	71
Corn Syrup	.....	.....	.....	.....	.....	15	30	24
Maple Syrup	.....	.....	.....	.....	60	10	68	.....
Sugar	148	.....	88	206	122	95	87	184

TABLE 21.—Specific Foods Used by Individual Preschool Children During Each Season of a 2-year Period—Continued

Child III

Food	1932				1933			
	Winter	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn
	Grams	*Grams*	*Grams*	*Grams*	*Grams*	*Grams*	*Grams*	*Grams*
Milk	3549	4258	3051	3930	3998	5060	4783	3752
Bread, Wholé Wheat	188	153	49	223	150	227	253	172
Bread, White	248	113	211	59	80	76	41	225
Crackers, Soda	12	4	36	16	17		5	11
Crackers, Graham	40							
Cornflakes							44	
Grapenut Flakes								18
Wheatena						14		
Oats, Rolled	130	77	72	30	34	56	8	27
Cornmeal						13		
Ralston	113	113	62	32	26	25	36	24
Rice				8	5	10	23	14
Macaroni		23	16	9	8	19	5	10
Tapioca			14	14	5		3	
Cake and Cookies		52	74					37
Potatoes, Irish	84	44	2	153	229	298	329	250
Asparagus							23	
Beans, Green				24				31
Beets	21		40	30	87	78	67	
Carrots	106	50	81	31	86	33	53	29
Cauliflower				22	13	26	26	23
Celery	46	33	12	47	16	14	5	16
Onions	6	16	24	8	8	12	18	28
Peas				62			47	
Tomatoes (Fresh)								120
Cabbage	9		20	15	3	3		
Lettuce				5			10	20
Spinach	95		12	33	38	55	146	38
Tomatoes (Canned)	422	552	745	638	708	561	430	201
Beans, Green (Canned)		24			72	166	91	
Corn (Canned)	100	27	55		162	58	44	
Peas (Canned)		53	22		55	38		71
Oranges	946	976	874	1013	1115	765	953	788
Apples	365	445		342	260	250	278	275
Bananas	18	96	34		144		90	80
Grapes								74
Peaches (Fresh)				144				152
Pears (Fresh)				242				
Rhubarb			51					
Strawberries			13					
Apricots (Dried)			75	74	107	83	55	94
Prunes (Dried)	131			18	99	145	69	75
Raisins		12			2			
Dates		59	12	132	8			90
Apricots (Canned)								100
Peaches (Canned)	352	218	297		383	252	158	100
Pears (Canned)				170	128	222	114	100
Pineapple (Canned)					160	100	240	
Eggs	286	252	328	243	207	258	261	67
Beef		8	15	45	56	40	35	125
Lamb						18	39	40
Liver				18	64	17	26	36
Haddock				22				
Salmon		60						
Veal			294					
Chicken	3							
Bacon	51	52	37	59	33	24	29	30
Butter	124	78	57	90	102	92	96	106
Corn Syrup			15	31			17	
Sugar	32	96	139	206	113	145	104	157

TABLE 21.—Specific Foods Used by Individual Preschool Children During Each Season of a 2-year Period—Continued

Child IV

Food	1932				1933			
	Winter	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn
	Grams	*Grams*	*Grams*	*Grams*	*Grams*	*Grams*	*Grams*	*Grams*
Milk	2391	3027	3922	4251	2972	3724	3490	3075
Bread, White	137	81	31	82	.....	7	.....	.....
Bread, Whole Wheat	171	166	126	154	187	172	187	209
Crackers, Graham	.....	.....	.....	33	.....	.....	10	.....
Crackers, Soda	13	.....	48	14	8	40	.....	.....
Cornflakes	.....	.....	.....	.....	10	.....	.....	.....
Rice Flakes	10	40	22	10	10	10	.....	.....
Oats, Rolled	73	25	.....	.....	.....	.....	.....	.....
Cream of Wheat	52	20	.....	21	20	.....	.....	.....
Cornmeal	.....	.....	.....	9	.....	19	.....	56
Farina or Ralston	84	80	12	40	14	.....	.....	.....
Macaroni	4	17	7	6	7	15	8	7
Rice	21	51	.....	19	.....	28	17	19
Tapioca	.....	.....	.....	.....	3	.....	2	1
Cake and Cookies	27	16	51	3	35	.....	10	51
Potatoes, Irish	362	642	438	406	375	394	342	727
Potatoes, Sweet	308	.....	.....	.....	.....	.....	.....	.....
Artichoke	34	.....	.....	.....	.....	.....	.....	.....
Asparagus	.....	.....	41	.....	.....	.....	55	.....
Beans, Green	.....	.....	.....	29	.....	.....	.....	74
Beets	52	.....	.....	.....	13	35	52	.....
Carrots	167	14	24	20	75	35	73	26
Cauliflower	.....	.....	13	39	26	32	23	45
Celery	73	55	.....	16	.....	44	.....	5
Onions	30	.....	16	10	4	14	16	22
Parsnips	.....	18	.....	.....	.....	.....	.....	.....
Peas (Fresh)	.....	.....	23	102	.....	.....	50	130
Tomatoes (Fresh)	2	.....	.....	.....	.....	.....	.....	.....
Cabbage	43	19	.....	15	9	3	.....	3
Lettuce	5	.....	.....	5	10	.....	.....	.....
Spinach	.....	124	133	29	34	42	113	59
Tomatoes (Canned)	.....	30	47	547	430	649	495	477
Asparagus (Canned)	38	.....	.....	.....	.....	.....	.....	.....
Beans, Green (Canned)	10	538	50	.....	100	190	102	.....
Beans, Lima (Canned)	42	.....	.....	.....	.....	.....	.....	.....
Corn (Canned)	.....	.....	.....	.....	.....	45	31	.....
Peas (Canned)	44	100	.....	.....	58	105	.....	.....
Oranges	803	952	755	458	466	519	816	754
Grapefruit	.....	.....	.....	.....	.....	158	.....	124
Apples	.....	.....	29	95	158	76	106	244
Bananas	37	83	10	42	83	.....	22	30
Peaches (Fresh)	.....	.....	.....	137	.....	.....	.....	.....
Pears (Fresh)	.....	.....	.....	5	.....	.....	.....	59
Pomegranate	.....	.....	.....	.....	42	.....	.....	.....
Strawberries	.....	.....	.....	.....	.....	52	.....	.....
Apricots (Dried)	.....	.....	9	4	15	20	14	44
Prunes (Dried)	.....	.....	5	16	47	119	35	5
Dates	.....	.....	.....	.....	.....	2	.....	.....
Apricots (Canned)	.....	11	.....	.....	.....	.....	.....	.....
Pears (Canned)	10	22	.....	.....	90	133	90	10
Peaches (Canned)	.....	.....	.....	.....	141	109	171	109
Eggs	63	159	324	364	354	407	461	250
Beef	99	82	38	75	28	37	45	128
Lamb	.....	.....	50	.....	.....	44	41	47
Liver	.....	.....	61	43	18	131	41	62
Haddock	52	92	32	32	70	85	.....	25
Chicken	.....	42	.....	.....	16	.....	25	.....
Duck	.....	.....	.....	.....	.....	.....	.....	7
Turkey	.....	.....	.....	.....	.....	.....	.....	13
Bacon	56	31	50	41	59	44	21	29
Butter	195	193	97	113	88	124	70	110
Jelly	.....	.....	.....	.....	.....	8	.....	.....
Candy	.....	.....	.....	12	.....	10	.....	.....
Maple Syrup	.....	.....	.....	131	201	96	43	170
Corn Syrup	.....	.....	.....	36	27	43	30	26
Honey	.....	.....	.....	.....	.....	4	.....	.....
Sugar	54	61	16	103	50	57	40	111

TABLE 21.—Specific Foods Used by Individual Preschool Children During Each Season of a 2-year Period—Continued

Child V

Food	1932				1933			
	Winter	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn
	Grams	*Grams*	*Grams*	*Grams*	*Grams*	*Grams*	*Grams*	*Grams*
Milk	3835	4305	4356	4371	3794			
Bread, White		25	135	111	26			
Bread, Whole Wheat	191	197		60	100			
Crackers, Graham	115	48		163	100			
Grapenuts			135					
Grapenut Flakes					18			
Rice Flakes				43	74			
Shredded Wheat	144	166		38				
Little Crow Cereal	33	9						
Oats, Rolled	6							
Macaroni			6	4	7			
Rice			2	3	4			
Tapioca	7			5	5			
Cake and Cookies	17	37						
Potatoes, Irish	155	143	202	403	265			
Beans, Green			6	33				
Beets	72	81	17	28	77			
Carrots	4	4	31	20	66			
Cauliflower				6	10			
Celery		10	10					
Onions			4	4	4			
Peas (Fresh)			8	32				
Cabbage	6		9	6	3			
Lettuce	10	5	5	20	5			
Spinach	33	66	29	71	25			
Beans, Green (Canned)	100	33			38			
Corn (Canned)					22			
Peas (Canned)					4			
Tomatoes (Canned)	9	378	147	407	435			
Oranges	695	777	988	821	344			
Grapefruit	4							
Apples	226	211	103	335	321			
Bananas	87	100	371	100	162			
Peaches (Fresh)				253				
Rhubarb		128						
Apricots (Dried)			25	89	31			
Prunes (Dried)					193			
Raisins					1			
Cherries (Canned)	10							
Peaches (Canned)	129	170			340			
Pears (Canned)				142	270			
Prunes (Canned)		218						
Eggs	23	19	32	93	54			
Beef	13	18	29	51	68			
Lamb			22					
Liver	3		9	13	33			
Haddock				14	10			
Bacon	12	7						
Butter	133	116	77	73	85			
Jelly	24							
Corn Syrup				25				
Sugar	243	165	186	245	124			

TABLE 21.—Specific Foods Used by Individual Preschool Children During Each Season of a 2-year Period—Continued

Child VI

Food	1932				1933			
	Winter	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn
	Grams	*Grams*	*Grams*	*Grams*	*Grams*	*Grams*	*Grams*	*Grams*
Milk, Top				148				
Milk, Skim			67					
Milk, Whole	3953	5811	6158	5000	5118	5428	4874	4642
Bread, White	90		116	255	93	116	19	42
Bread, Whole Wheat	59	544	129	75	305	287	266	364
Bran Flakes					37	20	20	
Corn flakes				14			30	
Rice Flakes							34	67
Puffed Wheat						4		
Shredded Wheat			15	28				
Oats, Rolled	20	21	52	44	15	56		52
Cream of Wheat	39	18						
Rice		24	19	17	21	20	14	36
Macaroni		11	20	6	19	18	11	9
Tapioca		6	8	7		5		
Cake and Cookies	138					28		
Potatoes, Irish	577	411	556	346	763	481	422	708
Potatoes, Sweet	44							
Asparagus						9		
Beans, Green				50				
Beets	22				13	61	100	
Carrots	18	141	82	67	114	140	97	123
Cauliflower	23	19	48	16	51	106		80
Celery	21	5		25	8	5		35
Onions	24	16	35	18	8	22		45
Peas (Fresh)			137	76			124	
Tomatoes (Fresh)								155
Turnips	6				15			26
Cabbage	40	53	12	52	31			108
Lettuce	53	10	30	10	25	5	5	64
Spinach	292	58	46	160	105	168	290	50
Tomatoes (Canned)	494	531	439	442	621	525	133	212
Beans, Green (Canned)	91	128	31		62	252	46	
Corn (Canned)	78						36	
Peas (Canned)	66	98			58	64		
Oranges	90	443	90	90	544	436	505	530
Grapefruit		136						
Apples	365	346	181	251	331	363	150	161
Bananas			99		179	167	231	151
Peaches (Fresh)				108				92
Pears (Fresh)				108				
Apricots (Dried)	154	43	87	104	185	49		108
Prunes (Dried)	44	84	63			256	152	97
Raisins			8			55		
Apricots (Canned)		60					300	
Peaches (Canned)	198	172	258		172	100	200	250
Pears (Canned)					200	620	380	300
Pineapple (Canned)	57	25						
Eggs	212	273	415	333	231	280	332	226
Beef	43	71	51	56		68	112	83
Lamb	70				56	24		79
Liver	24	22	36	34	29		89	67
Chicken						11		
Haddock		31	32	22	39			
Tuna Fish	6							
Bacon	8							
Butter	93	162	101	118	127	130	69	96
Candy	70	2						
Preserves	22							
Sugar	180	205	120	191	196	136	75	150
Corn Syrup	35	30	17	25		30		

TABLE 21.—Specific Foods Used by Individual Preschool Children During Each Season of a 2-year Period—Continued

Child VII

Food	1932				1933			
	Winter	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn
	Grams	*Grams*	*Grams*	*Grams*	*Grams*	*Grams*	*Grams*	*Grams*
Milk, Skim			158				820	
Milk, Top			17				456	
Milk, Whole	4384	4729	5588	4680	3672	4543	4750	5349
Cream	24		82					
Bread, White	134	118	67	204	178	67	41	61
Bread, Whole Wheat	167	140	448	161	184	203	173	336
Crackers, Graham		24		5			89	
Crackers, Soda				20				66
Bran Flakes	49				52		46	
Rice Flakes			2					
Shredded Wheat							148	33
Oats, Rolled	7	10	14		21	60		19
Ralston or Farina	13	36	14	121	67	34		76
Cream of Wheat		13						
Rice		14	10	48			7	36
Macaroni	15	7		11	9		8	
Tapioca	7	6	5	8	5		5	3
Cake and Cookies	96	52		144	38	186		137
Pretzels	44							
Potatoes, Irish	377	499	658	490	693	463	499	802
Asparagus							27	
Beans, Green				57				64
Beets	20				113	46	10	
Carrots	72	71	69	100	75	40	84	53
Cauliflower	22	16	65	13	32	48	23	48
Celery	15	10		42	10	26	15	15
Onions	10	16	14	14	16	22	45	27
Peas (Fresh)			68	78			64	114
Cabbage	62	19	12	34		3		3
Lettuce	10	5	19	5	5		5	5
Spinach	38	79	113	158	67	58	146	112
Tomatoes (Canned)	512	482	603	491	548	631	504	603
Beans, Green (Canned)	90	38	105		166	228	83	
Corn (Canned)					42	14	57	
Peas (Canned)	75	78			34	128		
Oranges	1316	942	1022	406	677	643	514	699
Grapefruit		40				288		
Apples	534	364	308	478	252	159	139	299
Bananas	62			42	114	32	142	250
Peaches (Fresh)				107				
Pears (Fresh)				114				124
Pineapple (Fresh)							116	
Rhubarb		58						
Strawberries							634	
Apricots (Dried)	56	70	87	63	31	23	17	119
Prunes	77	84	71		105	130	42	52
Raisins			13					
Dates								
Peaches (Canned)		123			286	212	221	89
Pears (Canned)	106	68			233	252		201
Cherries (Canned)								110
Pineapple (Canned)				105	48			
Eggs	163	248	293	301	247	111	183	213
Beef	95	77	50	59	159	80	50	57
Lamb	118		50			37	32	53
Liver	13		29	36		33	51	64
Haddock		18	19	38	12			29
Chicken		20						
Bacon		27	21					
Butter	172	88	136	121	131	95	103	95
Jelly					9			
Honey			30					
Candy							50	27
Corn Syrup	30	29	29	25	26	34	30	26
Sugar	152	137	179	142	113	107	142	144

TABLE 21.—Specific Foods Used by Individual Preschool Children During Each Season of a 2-year Period—Continued

Child VIII

Food	1932				1933			
	Winter	Spring	Summer	Autumn	Winter	Spring*	Summer	Autumn
	Grams	*Grams*	*Grams*	*Grams*	*Grams*	*Grams*	*Grams*	*Grams*
Milk, Whole	5095	5575	4756	6115	5543	2889	4965	6203
Cream						130		
Bread, White	64	50	78			27	8	9
Bread, Whole Wheat	68	136	67	247	231	92	135	194
Crackers, Graham		20				6		34
Crackers, Soda	6	32			16			
Bran Flakes	26	10	20			18		10
Corn Flakes					10			
Grapenut Flakes			10					
Rice Flakes	20	10	6	20				43
Shredded Wheat				56	18			
Cream of Wheat		27	7					
Farina or Ralston		26	8	14	23		70	35
Hominy		10						
Macaroni	11		11	5	12	12	13	9
Oats, Rolled	29	13		33	26	17		
Rice			7	9	11	13	15	14
Tapioca		5	5	4	8			
Cakes and Cookies	35	14	87	66	28		42	110
Potatoes, Irish	293	450	286	317	292	215	334	473
Potatoes, Sweet								136
Asparagus							36	
Beans, Green				48				29
Beets	33				41	59	93	
Carrots		147	57	63	100	9	42	49
Cauliflower	16	19		13	26	16	3	6
Celery	41	13		37	30	20	5	8
Cucumbers							7	
Onions	18	44		14	14	14		22
Peas (Fresh)			9	57			50	40
Radishes							8	
Turnips		23						
Tomatoes (Fresh)			105				49	
Cabbage	47	12	46	59	13			25
Lettuce	15	5	40	40	9		4	15
Spinach	137	95	448	59	50	21	500	116
Tomatoes (Canned)	490	595	43	413	405	370	109	279
Beans, Green (Canned)	219		43		62	62	57	
Beans, Lima (Canned)			63					
Corn (Canned)			55			38	45	
Peas (Canned)	120	31			51	44		
Oranges	318	383	691	378	515	377	999	846
Grapefruit	340	380	180	246	294	200		210
Apples	106	111	25	322	467	134	194	256
Bananas	63		107		217		88	51
Grapes				14				
Grapejuice				218				
Peaches (Fresh)				112				
Pears (Fresh)				40				75
Rhubarb			53					
Strawberries	42		8				100	
Apricots (Dried)	51			62	47	2		104
Prunes (Dried)	44				20	105	56	11
Raisins					4			
Apricots (Canned)								92
Peaches	140		80			52	187	133
Pears (Canned)			99		60	80	40	72
Pineapple (Canned)	85							
Plums (Canned)		328						
Raspberries (Canned)	20		85					
Eggs	131	164	121	301	199	66	327	214
Beef	58	44	35	73	56		70	105
Lamb		65	8					118
Liver	16	31		32	33	18	51	145
Salmon	23							
Haddock			46	17	25			29
Ham	5							
Wiener			35					
Tuna Fish		31						
Bacon	17		22	11	9	30	13	
Butter	140	159	114	112	99	51	78	101
Candy		18	9	2	30	20	12	235
Jelly	59		54		8			7
Maple Syrup	87	60						73
Honey					45			
Corn Syrup	35	40	17	25	20	20	30	16
Sugar	172	155	97	204	119	95	96	118

*These quantities represent four days' intake.

TABLE 21.—Specific Foods Used by Individual Preschool Children During Each Season of a 2-year Period—Concluded

Child IX

Food	1932				1933			
	Winter	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn
	Grams	*Grams*	*Grams*	*Grams*	*Grams*	*Grams*	*Grams*	*Grams*
Cream						24		
Milk, Whole	3140	4285	3577	3814	3031	5280	4487	4755
Milk, Skim			202	1208	1174	120	1037	1217
Bread, White	408	263	333	237	287	208	180	103
Bread, Whole Wheat	138	92	146	209	202	260	268	190
Crackers, Soda				19	24	14	34	14
Crackers, Graham							12	10
Corn Flakes	12		11		12	20	20	
Grapenut Flakes				14				
Puffed Wheat						10		20
Shredded Wheat		18						
Cream of Wheat		16		17	20	18		
Little Crow Cereal			17	20				
Farina or Ralston	26	2		6	40	18	41	32
Macaroni	19	15	22	10	16	15	13	7
Oats, Rolled	50	14	33	36	51	54	40	33
Rice	21	25	49	17	20	19	41	32
Tapioca		5	9	5	5		3	3
Cake and Cookies	52			45				
Potatoes, Irish	390	408	336	392	611	371	409	667
Asparagus			14				4	
Beans, Green				65			88	110
Beets	33				67	48	135	
Carrots	149	40	24	71	86	63	91	44
Cauliflower	19	16	29	23	67	35	16	48
Celery	5	5	32		20	74		10
Onions		14	24	27	18	22	29	27
Peas (Fresh)				86				110
Cabbage	40	6	12	68	3			3
Lettuce	20	15	30	5	10	35		10
Spinach	125	91	45	141	121	66	192	100
Tomatoes (Canned)	1195	726	495	621	496	631	582	222
Beans (Canned)	76	133	138		54	171	138	
Corn (Canned)					29		57	
Peas (Canned)	33	97	94		73	63	64	
Oranges	404	387	472	261	449	541	1066	795
Apples	272	75	234	217	241	158	315	387
Bananas	136	72	255	156	255	301	278	93
Peaches (Fresh)				132				
Pears (Fresh)				117				113
Apricots (Dried)	89	84	87	78	31	20	28	78
Prunes	109	84	63	34	168	64	98	87
Raisins			3	10	7			
Dates		54						
Peaches (Canned)		123			127		281	144
Pears (Canned)	146	210	191	130	244	360	180	142
Apricots (Canned)			64			454		
Grapefruit (Canned)		58						
Eggs	148	207	145	163	71	91	122	140
Beef	39	102	32	79	118	70	80	51
Lamb	121		26			48	57	70
Liver	36	34	33	44	39	36	57	78
Haddock		18	75	28	21			29
Bacon	49	12						
Butter	145	79	112	139	170	143	129	97
Corn Syrup	52	39	23	25	26	28	30	
Sugar	142	153	156	192	126	106	129	153

Milk.—The importance of milk in the diets of children has been noted many times. No other food can take its place completely, because no other food reinforces the diet at so many places. As shown by Table 21, the habit in regard to milk consumption varied greatly among the individual children, the average amounts used during the observation periods ranging from less than 1½ cups to slightly over 4 cups daily.

Every child was taking more milk daily at the end of the period of the study than he was taking at the beginning of the study. The average daily intake during the last season of the study was 3.14 cups, as compared to a daily average intake of 2.31 cups at the beginning of the study.

For half the children, the average amount of milk used daily remained approximately the same for each of the 2 years. For the remainder of the group, there was an increased use of milk daily during the second year.

Amounts given in the table include milk used as a beverage, as well as that used in food preparation. It is of interest that children using the smaller amounts of milk were the ones who were using the least as a beverage and the largest proportions in food preparation. These figures emphasize the fact that the habit of using milk as a beverage is the best assurance of generous intakes of milk and, therefore, constitutes an important "factor of safety" in the diet for children. Interestingly enough, the average amount used daily increased consistently from winter through autumn for each year, although the average amount used the second winter was slightly less than that used during the preceding autumn.

Vegetables and fruits.—An interesting variety of vegetables was found in the diets of this group of children. In addition to white potatoes, the variety of vegetables used ranged from fourteen, the smallest number in any of the diets, to twenty-one, the largest number used by any one of the children. The fact that such young children had become accustomed to and ate so many varieties of vegetables emphasizes the fact that early childhood is a desirable time to establish good dietary habits.

Fruits, including fresh, canned, and dried, were used in a wide variety. Oranges and apples were used in larger amounts than were other fruits, but the fact that the children ate from 12 to 19 varieties shows how desirable the practice in regard to the use of fruit was.

Eggs, meat, poultry, and fish.—Eggs were used in fairly generous amounts by all but one child, the amounts used varying from season to season. Beef, lamb, liver, bacon, and haddock were eaten by all the children. Chicken appeared in the diets of six of the nine children. Other foods of this class, such as turkey, duck, "wieners", veal, ham, and tuna fish, appeared only occasionally in individual dietaries.

Fats.—Butter was the only fat used as such by this group of children. In a few cases, other fats were used in the preparation of food.

Sugars and other sweet foods.—Corn syrup was added to the tomato juice given the nursery school children and, therefore, appeared on every diet list. Sugar also appeared in every child's diet in amounts ranging from 32 to 245 grams weekly. In view of the fact that sugar contributes nothing but calories to the diet and that early childhood is a period when food habits are best and most easily established, the liberal use of sugar by this group of preschool children might be questioned. As Sherman has said, "It is a sobering thought that sugar as it now comes into commerce, is the most completely devoid of proteins, vitamins, and mineral elements of all the foods we give our children" (19).

For a third of the children, sugar and corn syrup were the only foods of this group which were used. The remainder of the children had, in addition, maple syrup, honey, preserves, jelly, or candy.

The extent to which cod-liver oil was taken by individual children is shown in Table 22. For most of the children, cod-liver oil was given during the period they were in the nursery school. The calorie value of cod-liver oil used has not been included in the calorie value of the diets.

TABLE 22.—Cod-liver Oil Intake of Individual Preschool Children

Child	Winter		Spring		Summer		Autumn	
	Days per week	Teaspoonful per day	Days per week	Teaspoonful per day	Days per week	Teaspoonful per day	Days per week	Teaspoonful per day
First Year								
1	.....	.....	.....	.....	.....	.....	.....	.....
2	6	¾	.....	.....	.....	.....	.....	.....
3	7	1	7	2	.....	.....	7	2
4	6	¼	.....	.....	.....	.....	5	1
5	.....	.....	.....	.....	.....	.....	5	1
6	5	1	5	1	5	1	5	1
7	5	1	5	1	5	1	5	1
8	5	1	5	1	5	1	5	1
9	6	1	6	1	5	1	5	1
Second Year								
1	.....	.....	1	1	4	1	5	1
2	5	1	1	1	5	1	4	1
3	3	1	7	2	.....	.....	.....	.....
4	5	1	5	1	5	1	5	1
5	5	1	.....	.....	.....	.....	.....	.....
6	5	1	5	1	.....	.....	.....	.....
7	5	1	5	1	5	1	5	2
8	5	1	3	1	5	1	.....	.....
9	5	1	5	1	5	1	.....	.....

GROWTH OF CHILDREN AS SHOWN BY GAINS IN HEIGHT AND WEIGHT

Each child was weighed and his height determined monthly. Nude weights were obtained. Weighings were always made at approximately the same time of day, there being usually less than one hour's variation in weighing time. In addition, each child emptied his urinary bladder just before he was weighed. These precautions have been shown to be important in the determination of accurate weights for children (23).

Recumbent lengths were obtained, as well as standing heights. The recumbent lengths were obtained by use of a measuring board which was graduated to eights of inches and which had a stationary piece at one end and a movable one at the other.

In order to compare the increases in height and weight by season, the seasons in Columbus, Ohio, have been assumed to be as follows: winter—December, January, and February; spring—March, April, and May; summer—June, July, and August; and autumn—September, October, and November.

Average monthly gains or losses in weight for each season of each year, as well as total gains for each child, are given in Table 23 and Figure 17. Expected gains in weight are also shown. For the first year, the figures given are for 11 months. For the second year, the figures are for 12 months. Average monthly gains or losses for the 2 years are shown in Figure 18.

TABLE 23.—Monthly Gains or Losses, in Pounds, of Nine Preschool Children

Child	Winter				Spring				Summer				Autumn				Total	Average per month	Woodbury Standard
	Dec.	Jan.	Feb.	Average	Mar.	Apr.	May	Average	June	July	Aug.	Average	Sept.	Oct.	Nov.	Average			
First Year																			
1									0.25	0.75	0.78	0.59	0.79	0.74	0.38	0.64	3.69	0.62	0.40
2		0.56	0.56	0.56	0.56	0.57	1.44	0.86	−1.25	0.13	0.53	−0.20	0.53	−0.50	1.09	0.37	4.22	0.38	0.38
3		0.93	0.19	0.56	−0.75	0.56	0.13	−0.02	−0.19	−0.50	0.75	0.02	0.75	1.31	0.44	0.83	3.62	0.33	0.38
4		0.25	0.37	0.31	0.13	0.56	−0.25	0.15	0.37	−0.12	0.56	0.27	0.56	0.57	1.19	0.77	4.19	0.38	0.37
5		0.62	0.44	0.53	−0.37	0.19	0.74	0.18	−0.18	0.56	0.50	0.29	0.50	−0.69	2.25	0.69	4.56	0.41	0.38
6		−0.68	1.94	0.63	−0.03	−0.04	1.31	0.41	0.53	0.53	0.53	0.53	0.54	1.94	−0.13	0.78	6.44	0.59	0.35
7		0.12	0.44	0.28	−0.56	1.81	−0.06	0.40	0.06	0.23	0.23	0.17	0.23	1.00	0.75	0.66	4.25	0.39	0.34
8		0.50	−0.26	0.12	1.19	−0.31	0.69	0.52	0.81	1.25	0.12	0.73	0.13	1.25	−0.37	0.34	5.00	0.45	0.31
9		−0.24	0.31	0.04	0.56	0.37	0.13	0.35	0.69	0.20	0.21	0.37	0.21	0.44	1.00	0.55	3.88	0.35	0.29
Average per Child per Month per Season				0.38				0.36				0.31				0.63			
Second Year																			
1	1.25	0.13	0.43	0.61	0.25	−1.44	0.69	−0.17	−0.19	0.94	0.94	0.56	0.94	0.75	−0.25	0.48	4.44	0.37	0.34
2	1.09	0.19	0.25	0.51	0.56	0.82	0.00	0.18	−0.25	0.33	0.34	0.14	0.33	0.69	0.56	0.59	4.91	0.41	0.32
3	1.06	−0.06	0.56	0.55	0.13	0.00	0.43	0.17	0.57	0.62	0.63	0.61	0.62	−0.18	1.18	0.54	5.56	0.46	0.32
4	−0.50	0.62	2.19	0.77	0.37	0.13	0.43	0.31	−1.31	0.67	0.68	0.01	0.67	0.67	0.00	0.45	4.62	0.39	0.33
5																			
6	1.50	0.44	0.31	0.75	0.16	0.17	0.17	0.17	0.37	0.38	0.37	0.37	0.38	1.63	−0.76	0.42	5.12	0.43	0.30
7	1.56	−0.75	1.44	0.75	−0.69	1.00	0.81	0.37	−0.68	−0.69	0.90	−0.16	0.91	1.75	−0.50	0.72	5.06	0.42	0.28
8	−0.20	0.94	0.69	0.48	0.69	1.00	−0.50	0.40	0.19	1.29	1.29	0.92	1.29	3.06	−2.09	0.75	7.65	0.64	0.28
9	0.00	−0.18	0.50	0.11	1.12	0.44	0.62	0.73	1.25	0.41	0.42	0.36	0.42	0.32	0.47	0.40	4.79	0.40	0.32
Average per Child per Month per Season				0.56				0.31				0.35				0.54			

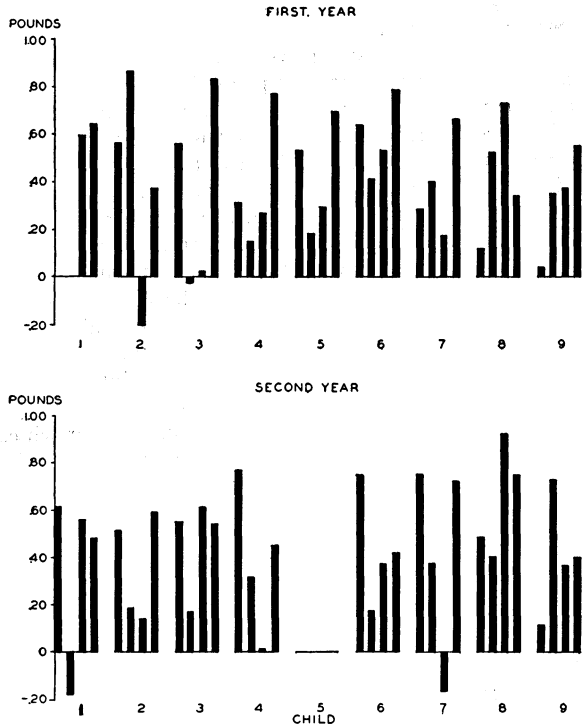

Fig. 17.—Average seasonal variations in gains or losses in pounds of individual preschool children during each of two years

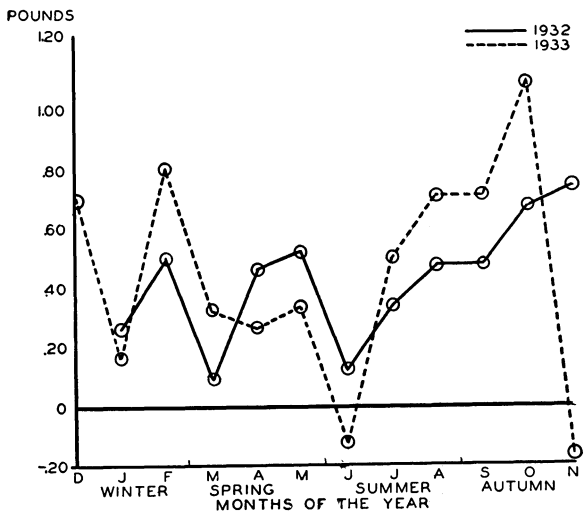

Fig. 18.—Average monthly gains or losses in pounds of preschool children during each of two years

During the first year, only one child failed to reach the Woodbury Standard of the expected gain in weight (30). For the second year, every child made or exceeded the expected gain in weight.

As shown by average gain in pounds per child for the four seasons of the first year, autumn seemed most favorable to increases in weight, with winter second, spring third, and summer least favorable, gains for the three latter seasons dropping much below the gains for the autumn. Considering monthly increases for individual children for the first year, six of the eight children made their greatest gains in autumn, one in the summer, and one in spring.

During the second year, the situation changed somewhat, inasmuch as the greatest average gain came in the winter; whereas autumn occupied the second place, summer, the third, and spring seemed least conducive to gains in weight. Four children made their greatest gain in weight during the winter, two in the summer, and one each in spring and autumn.

Considering both years together, the seasons seemingly most conducive to increase in weight, both from the standpoint of average gains per month per season, as well as from the standpoint of the seasons during which the largest number of children made their greatest gains, were autumn and winter. The clustering of the cases around autumn and winter of the 2-year period is interesting, in that these two seasons represent 6 consecutive months and suggest that something in the environment during the period was especially conducive to growth, since only one child had his greatest weight increase in the following autumn, although the average weight increase of the group for autumn was only slightly below that which was made during the winter. A former study made by Brown and McKay of children under conditions very similar to those of the present study, but in which more children were involved, showed that the greatest increases in weight were made during the autumn, with summer as the next most favorable season (13). These results from both studies emphasize the fact that autumn is a season favorable to increase in weight.

Interestingly enough, this small group of children averaged approximately the same average gain per month as did the larger group referred to above—namely, 0.43 pound per month, as compared to 0.41 pound per month for the larger group.

As a result of his study of seasonal variations in the growth in weight of elementary school children, Palmer has reported that "maximum rates of average growth in weight are observed during the fall months, intermediate ones during the winter, and minimum rates during the spring" (15).

In an attempt to determine the possible influence of the food intake upon the gain in weight of each child, food intakes for the year have been designated as high, or second high, and low, or second low, in regard to total calories, protein, calcium, phosphorus, and iron per kilogram. For the season of greatest weight increase for each child, the food intake was noted in regard to the above nutrients as high or low.

For the 2-year period, high intakes of total calcium and of phosphorus per kilogram occurred twice as frequently during periods of greatest weight increases as did low intake of the two food factors. High intakes of calories per kilogram, protein per kilogram, total phosphorus, total iron, and iron per kilogram occurred during the period of greatest gains in weight in nine out of fifteen instances. The number of cases is, of course, too small to justify definite conclusions. They point to the conclusion, however, that high intakes per kilogram are associated with greatest gains in weight.

Gains in height per month, as well as per year, have been recorded for each child for each of the 2 years, Table 24 and Figures 19 and 20. During the first year, one child failed to make the expected gain of Woodbury. Every child made or exceeded his expected gain during the second year.

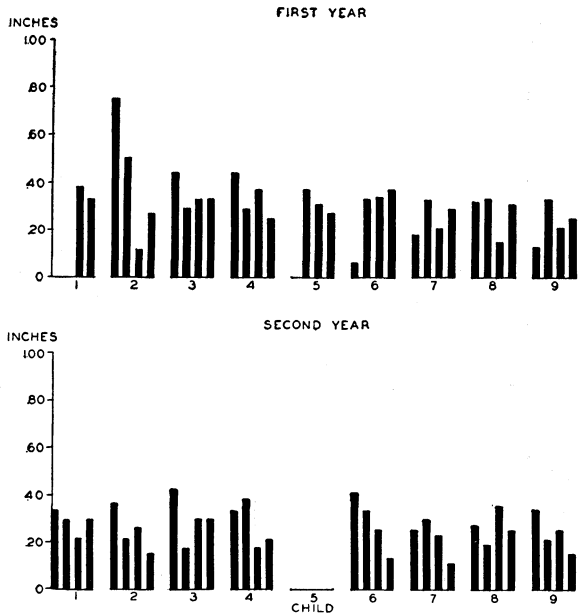

Fig. 19.—Average seasonal variations in gains in inches of individual preschool children during each of two years

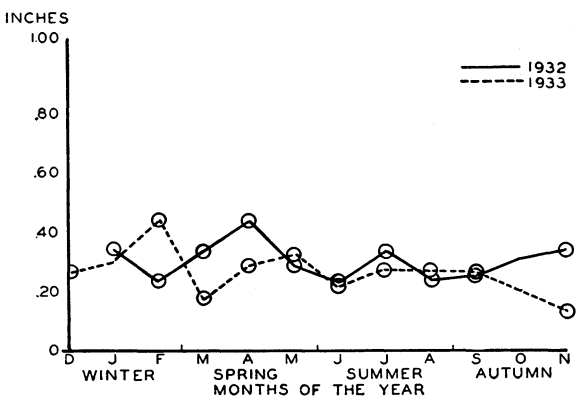

Fig. 20.—Average monthly gains in inches of preschool children during each of two years

TABLE 24.—Monthly Gains, in Inches, of Nine Preschool Children

Child	Winter				Spring				Summer				Autumn				Total	Average per month	Woodbury Standard
	Dec.	Jan.	Feb.	Average	Mar.	Apr.	May	Average	June	July	Aug.	Average	Sept.	Oct.	Nov.	Average			
First year																			
1.									0.38	0.38	0.37	0.38	0.37	0.38	0.25	0.33	2.13	0.36	0.31
2.		0.75	0.75	0.75	0.75	0.75	0.00	0.50	0.00	0.00	0.37	0.12	0.38	0.00	0.43	0.27	4.18	0.35	0.29
3.		0.63	0.24	0.44	0.13	0.25	0.50	0.29	0.50	0.50	0.00	0.33	0.00	0.62	0.38	0.33	3.75	0.31	0.29
4.		0.50	0.38	0.44	0.00	0.62	0.26	0.29	0.37	0.75	0.00	0.37	0.00	0.38	0.37	0.25	3.63	0.30	0.28
5.		0.00	0.00	0.00	0.38	0.24	0.50	0.37	0.26	0.37	0.31	0.31	0.32	0.24	0.26	0.27	2.88	0.24	0.27
6.		0.00	0.13	0.06	0.43	0.44	0.13	0.33	0.34	0.34	0.34	0.34	0.35	0.50	0.26	0.37	3.26	0.27	0.26
7.		0.37	0.00	0.18	0.38	0.50	0.12	0.33	0.13	0.25	0.25	0.21	0.25	0.38	0.24	0.29	2.87	0.24	0.24
8.		0.50	0.13	0.32	0.37	0.26	0.37	0.33	0.00	0.13	0.31	0.15	0.31	0.12	0.50	0.31	3.00	0.25	0.22
9.		0.00	0.26	0.13	0.24	0.38	0.38	0.33	0.12	0.25	0.25	0.21	0.25	0.13	0.37	0.25	2.63	0.22	0.21
Average per Child per Month per Season				0.29				0.35				0.27				0.30			
Second year																			
1.	0.25	0.00	0.75	0.33	0.25	0.38	0.24	0.29	0.13	0.25	0.25	0.21	0.25	0.50	0.12	0.29	3.37	0.28	0.25
2.	0.44	0.13	0.50	0.36	0.13	0.24	0.26	0.21	0.12	0.33	0.34	0.26	0.33	0.00	0.12	0.15	2.94	0.24	0.23
3.	0.00	0.75	0.50	0.42	0.00	0.00	0.50	0.17	0.13	0.37	0.38	0.29	0.37	0.12	0.38	0.29	3.50	0.29	0.23
4.	0.25	0.38	0.37	0.33	0.25	0.38	0.50	0.38	0.00	0.25	0.25	0.17	0.25	0.25	0.12	0.21	3.25	0.27	0.23
5.																			
6.	0.37	0.25	0.62	0.41	0.33	0.34	0.33	0.33	0.25	0.25	0.25	0.25	0.25	0.13	0.00	0.13	3.37	0.28	0.22
7.	0.13	0.50	0.13	0.25	0.24	0.26	0.37	0.29	0.25	0.25	0.18	0.23	0.19	0.00	0.13	0.11	2.63	0.22	0.20
8.	0.38	0.25	0.18	0.27	0.19	0.38	0.00	0.19	0.38	0.33	0.34	0.35	0.33	0.37	0.06	0.25	3.19	0.27	0.19
9.	0.37	0.13	0.50	0.33	0.00	0.25	0.38	0.21	0.50	0.12	0.13	0.25	0.12	0.25	0.08	0.15	2.83	0.24	0.22
Average per Child per Month per Season				0.34				0.26				0.25				0.20			

Both from the standpoint of number of children making their greatest gain in height and from the standpoint of greatest average gain in height for the group, spring appeared to be the season most favorable to height increases during the first year. Average gains in height were 0.35 inch during the spring, as compared to 0.30 inch for autumn, 0.29 for winter, and 0.27 for summer. Although only one child made his greatest gain in height during the autumn, average gain in height during that season was second highest for the year, showing that all children made good gains during that season.

For the second year, the greatest average gain in height occurred during the winter, with gains during spring, summer, and autumn occurring in descending order. Five of the eight children made their greatest gain during the winter, two during the spring, one during the summer, and none during the autumn.

The same situation prevailed during the 2-year period, both from the standpoint of average gains made and from the standpoint of the season during which the largest number of children made their greatest gains; winter ranked first, spring, summer, and autumn following in the order named. With the larger number of children who were included in the former study (13), the seasons seemingly most favorable to increases in height were summer and autumn, followed by spring and winter. Thus, the gains in height made by this smaller group of preschool children did not follow the pattern of the larger group in respect to season during which gains in height were greatest. See Table 25.

TABLE 25.—Comparison of Monthly Gains in Weight and Height of Nine Preschool Children With 173 Children*

Groups	Winter	Spring	Summer	Autumn
Weight—pounds				
Nine preschool children	0.47	0.34	0.33	0.58
173 children (2-7 years)	0.39	0.22	0.46	0.54
Height—inches				
Nine preschool children	0.32	0.30	0.26	0.25
173 children (2-7 years)	0.20	0.22	0.26	0.23

*McKay, H. and M. A. Brown. 1931. Seasonal Variation in the Rate of Growth of Preschool Children (13).

No correlation seemed evident between periods of greatest gains in height and the periods of high intakes of the various nutrients, except in respect to calcium intake per kilogram of body weight. In nine out of 15 instances, high calcium intakes per kilogram of body weight were associated with greatest gain in height.

Medical examinations were made periodically and each child was reported to be in good physical condition. During the 2-year period, illnesses occurred occasionally among the children. Toward the end of the period of the study, one child had chicken pox, followed by a tonsillectomy. Another child had a brief attack of measles. Slight digestive upsets were reported for two other children. Colds were relatively infrequent.

Dental examinations which were made periodically showed that in two cases second deciduous molars were non-erupted at the beginning of the study but in both cases were erupted shortly thereafter. The children were in good condition as far as teeth were concerned.

Such health habits as time spent out-of-doors, time spent in rest, and time spent in sleep may influence a child's rate of gain and general physical condition. The children of this group all had the habit of resting from 1½ to 2 hours in the afternoon. The older children varied slightly in the actual time of sleep during these rest periods, but the younger children were all good sleepers. The one older child who was a poor sleeper had a smaller total gain during the 2-year period than the older children, but one would hesitate to attribute this to the shorter amount of time spent in sleep on the evidence of a single case.

Considerable interest is attached to the length of time children take to eat their meals, the theory being sometimes advanced that the longer a child dawdles over his meal, the less he eats. For six of the children included in this study and for at least 2 weeks' time for all six with a longer period for some of them, careful observations were made of the length of time required by individual children to eat their noon meals in the nursery school. This length of time used from day to day varied from 17 to 52 minutes.

The child who ate his noon meal most quickly averaged 28 minutes for the entire period during which observations of the length of time required for the noon meal were made. The slowest child in this respect averaged 40 minutes. The average for the group was 33 minutes.

It is interesting to note that the slowest child, in regard to length of time required to eat the noon meal, was the child whose average calorie intake for the 2-year period was the lowest of the group. The child for whom the length of time required to eat the meal was approximately the same as the group average had the highest calorie intake of the group.

On the other hand, among individual children, higher calorie intakes were associated with the longer periods required to eat the meal. As far as these limited observations are concerned, individual children ate more when the period was longest, but among individual children those taking the longest time to eat their noon day meals had the smallest calorie intake.

SUMMARY AND CONCLUSIONS

By means of a dietary study made by the individual method, the food intake of a group of nine preschool children has been studied for one week of each of the four seasons of a 2-year period. Data concerning increases in height and weight have also been collected. Collection of data was made from January 1932 to January 1934.

The group studied consisted of nine normal, healthy children with an age range of from 19 to 40 months at the beginning of the study. All were from homes of an economic level which permitted adequate provision for food and for other needs. A weighed dietary study was made for each of six of the children during each of the four seasons of the 2-year period, a total of 8 weeks. Of the other three children, one was studied for 7, another for 6, and another for 5 weeks, each week consisting of 7 consecutive days and being considered indicative of the child's food habits for the season in question. Average figures concerning the food intake for the 2-year period are shown.

Although the group was small, the number of times each child's food intake was investigated gave a total number of cases large enough for statistical treatment. Fisher's t formula, designed to show the significance of relationships in small samples, was used.

By the use of this formula, the relationship between height and total calorie intake was shown to be more significant than either weight or age in relation to total calories, although they were both significant.

Total protein in relation to height was found to be somewhat more significant than in relation to weight, while age seemed to have no significant relationship in regard to total protein intake.

Total calcium showed a significant relationship to height, but little, if any, to age and weight.

Total phosphorus intake was related to weight, but more significantly to height.

Age, weight, and height were all significant in regard to iron intake, weight having a higher value than the other two.

Calorie intakes of individual children varied to a greater extent from day to day within each week than they did from season to season or from one year to the next. Factors which seemed to influence a child's calorie intake were: (1) The food intake itself—that is, the highest calorie intake either followed or preceded the lowest calorie intake in 36 per cent of the cases; (2) the type of food served; (3) the onset of colds; (4) excitement and emotional strain; (5) the days of the week, the first part of the week being seemingly more conducive to high calorie intakes than the end of the week; and (6) the season, calorie intakes during summer and autumn being less varied than during other seasons. Suitable food selection for preschool children and control of the environment to prevent emotional states which disturb the daily rhythm of a child's life are important. Further study of influences which cause such wide variations in calorie intake of preschool children might be of value.

Distribution of calories among the food groups differed from Rose's tentative standard, in that calories derived from the protein-high foods and from sugar were decidedly higher than the standard.

In the percentage of total calories derived from protein, fat, and carbohydrate, averages for individual children, as well as for the group, deviated from the pattern of 15, 35, and 50.

Records of increases in weight showed that, during each of the 2 years, all the children made or exceeded the expected gain of Woodbury. Autumn seemed especially favorable to increase in weight, in that the greatest average increase came during that period and in seven out of 15 cases individual children made their greatest gains during that period.

In nine out of the 15 instances, high intakes in regard to calories per kilogram, protein per kilogram, total calcium, total phosphorus, phosphorus per kilogram, total iron, and iron per kilogram were found during the periods of greatest gain in weight.

Only one child failed to make the expected gain in height during the 2-year period. Winter and spring seemed somewhat more favorable to increase in height than the other two seasons. No significant relationship could be seen between food intake and periods of low or high gains in height. Probably with children of this economic level, the food was always adequate to provide for the expected gains in height.

BIBLIOGRAPHY

1. Aldrich, C. A. 1927. Prevention of anorexia in children. J. A. M. A. **89**: 928.
2. Bartlett, W. M. 1928. An analysis of anorexia. Amer. Jour. Diseases of Children **35**: 26.
3. Cathcart, E. P., *et al.* 1932. Conference of experts for the standardization of certain methods used in making dietary standards. League of Nations' Health Organization Quarterly Bulletin **1**: 477. (Quoted in Exp. Sta. Rec. **70**: 276, 1934).
4. Davis, C. M. 1928. Self selection of diet by newly weaned infants. Amer. Jour. Diseases of Children **36**: 651.
5. Editorial. 1933. The protein intake of preschool children. J. A. M. A. **101**: 128.
6. Fisher, R. A. 1930. Statistical Methods for Research Workers. Third edition. Oliver and Boyd, London.
7. Harrington, M. M. 1930. Appetite in relation to weight. Jour. Amer. Dietetic Assoc. **6**: 101.
8. Holt, L. E. 1922. Food, Health and Growth. The MacMillan Co., New York.
9. Koehne, M. and E. Morrell. 1934. Food requirements of girls from six to thirteen years of age. Amer. Jour. Diseases of Children **47**: 548.
10. Leichsenring, J. M. and I. H. Flor. 1932. The iron requirement of the preschool child. Jour. Nutr. **5**: 141.
11. McKay, H. 1934. Iron in the diets of preschool children. Ohio Agr. Exp. Sta. Bimon. Bull. **19**: 73.
12. ————. 1934. Daily variations in calorie intake of a preschool child. Ohio Agr. Exp. Sta. Bimon. Bull. **19**: 118.
13. ———— and M. A. Brown. 1931. Seasonal variation in the rate of growth of preschool children. Ohio Agr. Exp. Sta. Bull. 482.
14. ———— and E. Evans. 1933. Protein used by preschool children. Ohio Agr. Exp. Sta. Bimon. Bull. **18**: 80.
15. Palmer, C. E. 1933. Seasonal variation of average growth in weight of elementary school children. U. S. Public Health Reports **48**: 211.
16. Rose, M. S. 1933. The Foundations of Nutrition. Revised edition. The MacMillan Co., New York.
17. ————, E. Robb, and G. M. Borgeson. 1932. The food consumption of nursery school children. Child Development **3**: 29.
18. ————, E. M. Vahlteich, E. Robb, and E. M. Bloomfield. 1930. Iron requirement in early childhood. Jour. Nutr. **3**: 229.
19. Sherman, H. C. 1929. The problem of sweets for children. American Child Health Association (New York), Child Health Bulletin **5**: 65.
20. ————. 1932. Chemistry of Food and Nutrition. Fourth edition. The MacMillan Co., New York.
21. Stearns, G. 1934. The retention of calcium from early infancy to adolescence. Jour. Biol. Chem. (Proceedings of the American Society of Biological Chemists) **105**: LXXXIV.

22. Stiebeling, H. K. 1932. The iron content of vegetables and fruits. U. S. D. A. Cir. 205.

23. Sumner, E. E. and J. Whitacre. 1931. Some factors affecting accuracy in the collection of data on the growth in weight of school children. Jour. Nutr. 4: 15.

24. Wait, B. and L. J. Roberts. 1932. The energy intake of well-nourished girls 10 to 16 years of age. Jour. Amer. Dietetic Assoc. 8: 209.

25. ———— and ————. 1932. Daily variations in energy intake of the individual. Jour. Amer. Dietetic Assoc. 8: 323.

26. ———— and ————. 1933. The protein intake of well-nourished girls 10 to 16 years of age. Jour. Amer. Dietetic Assoc. 8: 403.

27. ———— and ————. 1933. The mineral intake of 38 well-nourished girls 10 to 16 years of age. Jour. Amer. Dietetic Assoc. 9: 124.

28. Wang, C. C., R. Kern, and M. Kaucher. 1930. Minimum requirements of calcium and phosphorus in children. Amer. Jour. Diseases of Children 39: 768.

29. White House Conference on Child Health and Protection. 1932. Growth and development of the child. Part III. Nutrition. The Century Co., New York.

30. Woodbury, R. M. 1921. Statures and weights of children under six years of age. U. S. Department of Labor, Children's Bureau Pub. No. 87.

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